POTASSIUM NUTRITION ON VIVIPARY AND SEED QUALITY IN ORIENTAL PICKLING MELON (*Cucumis melo* var. *conomon* Mak.)

By

ATHULYA S KUMAR

(2017-11-148)

DEPARTMENT OF SEED SCIENCE AND TECHNOLOGY

COLLEGE OF HORTICULTURE

VELLANIKKARA, THRISSUR - 680 656

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THESIS

Submitted in partial fulfilment of the requirements for the degree of

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DEPARTMENT OF SEED SCIENCE AND TECHNOLOGY

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DECLARATION

I, hereby declare that this thesis entitled "**POTASSIUM NUTRITION ON VIVIPARY AND SEED QUALITY IN ORIENTAL PICKLING MELON (*Cucumis melo* var. *conomon* Mak.)**" is a bonafide record of research work done by me during the course of research and the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title, of any other University or Society.

Vellanikkara, **Athulya S Kumar**

Date: (2017-11-148)

CERTIFICATE

Certified that this thesis entitled "**POTASSIUM NUTRITION ON VIVIPARY AND SEED QUALITY IN ORIENTAL PICKLING MELON (*Cucumis melo* var. *conomon* Mak.)**" is a record of research work done independently by **Ms. Athulya S Kumar (2017-11-148)** under my guidance and supervision and that it has not previously formed the basis for the award of any degree, diploma, fellowship or associateship to her.

Vellanikkara,

Date:

Dr. Dijee Bastian

(Major Advisor, Advisory Committee)
Professor (Plant Breeding and Genetics)
Department of Seed Science and Technology
College of Horticulture
Vellanikkara

CERTIFICATE

We, the undersigned members of the advisory committee of **Ms. Athulya S Kumar (2017-11-148),** a candidate for the degree of **Master of Science in Agriculture** with major in Seed Science and Technology, agree that the thesis entitled **"POTASSIUM NUTRITION ON VIVIPARY AND SEED QUALITY IN ORIENTAL PICKLING MELON (*Cucumis melo* var. *conomon* Mak.)"** may be submitted by **Ms. Athulya S Kumar,** in partial fulfilment of the requirement for the degree.

Dr. Dijee Bastian
(Chairman, Advisory Committee)
Professor (Plant Breeding and Genetics)
Department of Seed Science and Technology
College of Horticulture, Vellanikkara

Dr. Rose Mary Francies
(Member, Advisory Committee)
Professor and Head
Department of Seed Science and Technology
College of Horticulture, Vellanikkara

Dr. P Prameela
(Member, Advisory Committee)
Professor
Department of Agronomy
College of Horticulture, Vellanikkara

Dr. C Beena
(Member, Advisory Committee)
Professor (Biochemistry)
AICRP on MAP & B
College of Horticulture, Vellanikkara

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Place : Vellanikkara

Date : *Athulya S Kumar*

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LIST OF ABBREVIATIONS

%	-	Per cent
μScm^{-1}	-	Micro Siemens per centimetre
^{o}C	-	Degree Celsius
B:C	-	Benefit cost ratio
cm	-	Centimetre
DAS	-	Days after sowing
dSm^{-1}	-	Deci Siemens per metre
EC	-	Electrical conductivity
FS	-	Foliar spray
g	-	Gram
HDP	-	High Density Planting
IMSCS	-	Indian Minimum Seed Certification Standard
K	-	Potassium
KAU	-	Kerala Agricultural University
kg	-	Kilogram
kg ha^{-1}	-	Kilogram per hectare
Kg/l	-	Kilogram per litre
kmph	-	Kilometres per hour
MAS	-	Months after storage
mg	-	Milligram
mm	-	Millimetre
MOP	-	Muriate of potash
MSL	-	Mean Sea Level
NUV	-	Near – Ultraviolet radiation
OP melon	-	Oriental Pickling melon
POP	-	Package of Practices
RH	-	Relative humidity
t/ha	-	Tonnes per hectare

Introduction

1. INTRODUCTION

Seed is the first and foremost important input for successful crop cultivation. Indian vegetable seed industry has been growing profoundly in quantity and value over the past fifty years. At present Indian seed industry is the fifth largest seed market in the world accounting for 4.4 per cent in global seed market. Indian seed market has grown at rate of 12 per cent while the growth rate of global seed market is only 5 per cent whereas the Indian vegetable seed market is growing at a rate of 10-15 per cent in a year. In 2018, the Indian seeds market reached a value of US$ 4.1 Billion, registering a CAGR of 15.7 per cent during 2011- 2018. It is further expected to grow at a CAGR of 13.6 per cent during 2019-2024, reaching a value of US$ 9.1 Billion by 2024 (ICFA, 2019). Vegetable seeds are high value low volume seeds and is recognized as a lucrative enterprise for improving the livelihood of farmers and addressing the issues of self-sufficiency, food security and economic development of remote areas (CEAPRED, 2014).

The availability of quality seed is of utmost importance for increasing the vegetable production. The growth of plant and the quality of seed produced are strongly influenced not only by genetic factors but also by the environmental condition. Precocious germination *i.e.,* vivipary in seed production which deteriorates the seed quality and quantity is a serious problem encountered in vegetable seed production. Vivipary is the condition whereby the embryo (the young plant within the seed) germinates, grows and breaks through the seed coat while the seeds still attached to the parent plant and characterized by the lack of seed dormancy (Batygina and Bragina, 2009).

Vivipary is detrimental because it causes yield and viability losses and leads to inferior nutritional and palatable qualities of fruits. This occurs as a result of complex hereditary and environmental factors and the influence of several genes (Zhang *et al.*, 2007), in addition to orchestrated phytohormone signaling (Farnsworth, 2000). The effects of temperature seem to vary, in some cultivars, lower temperatures and a higher relative humidity promote preharvest sprouting, whereas in others, warmer temperatures and high humidity promote it. Vivipary results in decreasing the quantity and quality of the seeds. Precocious germination is, therefore, significant from an agricultural perspective because the lack of seed dormancy with concomitant precocious germination in crops is a detrimental trait challenging the safeguarding of food supplies with simultaneous economic losses as a consequence of lower yields (Tsiantis, 2006).

Vivipary was reported in *Bruguiera, Ceriops, Kandelia*, *Rhizophora* species, all species of the family Rhizophoraceae (Farnsworth and Farrant, 1998), all species of *Avicennia* sp. and *Aegiceras corniculatum* (Göltenboth and Schoppe, 2006). Vivpary is also a recurrent phenomenon in various strains of maize (Neill *et al*., 1987), rice (Miyoshi *et al.* 2000), wheat (Derere *et al*., 1977), barley (Pope, 1949), rye (Kostoff, 1940), coconut (Sankaran *et al*., 2012), beans, rape seed (Ruan *et al*., 2000), papaya (Chakraborty and Chaudhari, 2008), and pecan (Wood and Reilly, 1999). Several investigators have reported this phenomenon in vegetables such as tomato (Downie *et al*., 1999), bell pepper (Yadav *et al*., 2011), Chinese cabbage (Ren and Bewley, 1999) watermelon (Kobayashi *et al*., 2010), musk melon (Welbaum *et al*., 1990), squash, grape fruit, egg plant (Singh and Khanna, 1979). Several studies reported its occurence in most of the cucurbitaceous vegetables.

Cucurbits are a major group of summer vegetable crops grown in tropical and subtropical climates. Oriental pickling melon (*Cucumis melo* var. *conomon* Mak.) is one of the major cucurbitaceous crop cultivated in Kerala. It is popularly known as *kani vellari*, and mainly grown for its golden yellow coloured fruits. The major cultivation of this crop is carried out prior to the festival *vishu* since it is a significant component of *vishu kanni*. Saubhaya and Mudicode are the two high yielding and most cultivated varieties of OP melon in Kerala.

The occurrence of vivipary in melon fruits of variety Saubhagya was reported during December (6.25%), January (3.60%) and February (1.44%) planting time (Nagendra *et al*., 2017). Different nutrient management practices can be carried out for reducing the viviparous sprouting in melon fruits. Studies shown that occurrence of viviparous sprouting can be reduced by high potassium fertilization (Ochi and Ito, 2012 a and b). In practical seed production of melon, side-dressing of potassium fertilizer after pollination may enable the reduction of the occurrence of viviparous sprouting. In seed production, nutritional conditions after pollination are important to enhance seed yield and quality. Exogenous application of ABA also reported to inhibit the occurrence of vivipary and resulted in marked increase of potassium absorption (Ochi *et al*., 2013).

In Kerala, so far no detailed investigations have been undertaken to study the the effect of higher potassium on the control of viviparous sprouting and the effect of genotypic difference in the occurrence of vivipary in Kerala conditions. In this context, an investigation entitled 'Potassium nutrition on vivipary and seed quality in oriental pickling melon (*Cucumis melo* var. *conomon* Mak.)' was formulated with the following objectives:-

1. To evaluate the effect of time of planting on vivipary and seed quality
2. To evaluate the influence of potassium levels on vivipary and seed quality
3. To assess the effect of different potassium levels during crop growth on the seed quality attributes during storability of seeds

Review of literature

2. REVIEW OF LITERATURE

Oriental pickling melon is a vegetable with cultural significance in Kerala. The low input requirements and the potential for high yields with short duration make this crop a profitable one. Vivipary, a physiological disorder is serious problem in seed production. Deficiency of potassium is one of the reason which mediates viviparous sprouting (Marrush *et al*., 1998). It is also considered to be genetic whereas, its manifestation can be modified to a large extent by environmental conditions.

Considering the above aspects, the present study 'Potassium nutrition on vivipary and seed quality in oriental pickling melon (*Cucumis melo* var. *conomon* Mak.)' was formulated. Literatures related to various aspects of the study are reviewed and discussed in brief under the given headings:

2.1 Influence of genotypes, planting dates on flowering, fruit and seed yield attributes

2.2 Impact of application of different potassium nutrient levels on flowering, fruit and seed yield attributes

2.3 Impact of storage period and different potassium nutrient levels during crop growth on seed quality and longevity

2.4 Seed health infection during storage

2.1 Influence of planting dates on flowering, fruit and seed yield attributes

Over the past few decades, crop weather relationship has received considerable attention. The response of crop towards weather and climate has been simulated, analyzed and assessed for carrying out research as well as for operational field assessment. The changes in sowing time can produce difference in production and productivity. The vegetative and reproductive phase of the plant is greatly influenced by the planting time. Proper planting time is crucial, from germination of seeds to their harvest. Environmental factors like rainfall, temperature, humidity and sunshine affect the growth and flowering of plants.

2.1.1 Days taken for first flower opening

Crop	Highlights of the experiment	Reference
Cucumber	The expression of femaleness in cucumber depended on the variety, temperature and day length.	Nonnecke, 1989
Musk melon	Late sowing recorded minimum duration for flowering than early sowing.	Farooq, 1992
Tinda gourd	Late sowing (April) recorded minimum duration for flowering (35.75 days) than early sowing (February).	Khan *et al*., 2001
Ash gourd	Days taken for female emergence was early in summer crop than rainy season in two varieties of ash gourd (CO 2 and Kerala local).	Murgeshan, 2003
Cucumber	The numbers of days to first male and first female flowers were significantly greater at December sowing due to low temperature while it was shortest for April.	Sharma *et al*., 2005
Helichrysum bracteatum (Medicinal plant)	Plantings dates were September 17, October 2, October 17, November 1, November 16 and December 1. Early sowing (September 17) took longer duration for flowering and produced more number of flowers per stem with larger flower size, than late sowing (December 1).	Sharma *et al.,* 2013
Okra	Time of flowering and duration of growth strongly influenced the climatic adaptation and yield potentials of a crop. Sowing date showed significant	Elhag and Ahmed, 2014

	effect on days to flowering. Late sowing (after third week of July) induced early flowering in two cultivars (Khartoumia and Wad Gammer) of okra.	
Tomato	Three sowing dates *viz.* October 1, 15 and 30 were considered and tomato varieties *viz*. BARI Tomato-2, BARI Tomato-3, BARI Tomato-4, BARI Tomato-9 and BARI Hybrid Tomato-4 were selected. Flowering differed significantly among tomato genotypes and sowing dates. Early flowering (52.40 days) was observed in October 1 and minimum (53.78 days) in BARI hybrid Tomato-4.	Hossain *et al*., 2014
Amaranthus	Eleven genotypes planted from March 2013 to January 2014 at bi monthly intervals. November sown recorded early flowering (41.91 days).	Shemon, 2014
Guar	Eight genotypes were planted during late April, mid-May, mid-June and early July for a span of two years (2014-15). Late April sowing recorded more number of days for fifty per cent flowering.	Singla *et al.,* 2016
Oriental pickling melon	The variety Saubhagya was planted at monthly intervals from August, 2016 to February, 2017. Early emergence of flowers (42.66 days) was recorded during late sowing (January).	Nagendra *et al*., 2017
Cucumber	Effect of different time of planting and variety on growth of cucumber was found to produce significant effect on female flowering. Sowing during	Longjam and Bijaya devi, 2017

	September produced female flowers earlier than sowing in December.	
Okra	Earliness with respect to days to first flowering (37.00) were observed under 20th July sown crop than other sowing dates.	Chawla *et al*., 2018
Karchikai (*Momordica cymbalaria*)	The plants were sown at four dates *viz*. June 1st, July 1st, August 1st and September 1st. The study showed that tubers planting on June 1st speed up days to flowering.	Mahantesh and Nishani, 2018
Cucumber	The date of planting exhibited marked influence on flowering related characters of cucumber that, first female flower produced 20.75 days of after sowing on early node of 1.55 at 15 September planting.	Maragal *et al*., 2018
Tomato	Effect of different time of planting and variety was significant on flowering days. Among the planting dates, minimum number of days (34.3) was taken by cultivars sowing on 30th January.	Ilyas *et al*., 2019

2.1.2 Fruit yield characters

Crop	**Highlights of the experiment**	**Reference**
Water melon cv. Sugarbaby	Crop was sown on 5 different dates between 10th November to 15th December. The good fruit quality and highest yield were obtained from the plants sown on 21st November.	Dessi and Patil, 1984

Cucumber	Early sowing on 3rd May gave the best yield in cucumber.	Yakimenko, 1984
Melon	The crop was planted at three different times in spring and the highest yield was given by middle spring sowing.	Bruton *et al*., 1985
Musk melon	Delayed planting in musk melon cv. *flexuosus* significantly decreased fruit weight and total fruit yield.	Muhammad *et al*., 1989
Musk melon	The plants sown in the second week of March gave maximum fruit volume, fruit weight, number of fruits per vine than later sowing.	Farooq, 1992
Water melon	The crop was raised at fortnightly intervals from November to January with various levels of irrigation. The highest fruit yield was obtained in crop sown on November 16th.	Neendissery, 1993
Tinda gourd	The early sowing of Tinda seeds give better yield performance and fruit quality.	Burki, 1996
Cucumber	Seven cultivars (Fancipak, Marinda, Donja, Ophix, Milglas, Pict andNiz 50-114) were sown from the first week of April at 15 days intervals up to May. The first sown crop in all varieties recorded highest fruit length, fruit diameter and fruit weight.	Sare *et al.,*1999
Melon	The plants were cultivated from mid-March to mid-June, or from mid-July to mid-September. Compared with spring, the plants grown in summer exhibited	Pardossi *et al*., 2000

	faster growth and development, but produced fewer fruits of larger size and poorer quality due to reduced sucrose content.	
Tinda gourd	The crop was planted at six dates of sowing *viz.* 28^{th} Feb, 10^{th} March, 20^{th} March, 30^{th} March, 9^{th} April and 19^{th} April. The maximum fruit weight (341.5 g) was recorded in 20^{th} March sowing and high yield was noted during 30^{th} March (2.05 t ha^{-1}).	Khan *et al*., 2001
Ash gourd	The fruit yield attributes and number of fruits per vine were highest in the rainy season sown crop and in Kerala local variety as compared to summer sown crop.	Murugeshan, 2003
Egusi melon (*Colocynthis citrullus* L.)	Five planting dates were chosen *i.e.*, April 2, 16 and 30 and May 14 and 28 for planting.The fruit and seed yields were increased as planting was done early in the season.	Ogbonna and Obi, 2007
Cucumber	Significant differences among two varieties are recorded in yield characters such as number of fruits per plant, fruit weight per plant and total yield per hectare.	Eifediyi and Remison, 2009
Melon	Marketable yield, average weight and number of marketable fruit of individual cultivars depended on weather conditions.	Zaniewicz-Bajkowska *et al*., 2009
Okra	Three planting dates (1 February, 15 February and 2 March) and three	Dash *et al*., 2013

	varieties (BARI Dherosh-1, Arka Anamica and Annie Oakley) were selected. Planting date had significant influence on yield contributing characters and yield of the three varieties tested. Higher pod yield with 15 February sowing was mainly due to increased number of pods/plant, pod size and pod weight.	
Okra	Planting dates influenced both yield and yield components. Early planting resulted in highest number of pods per plant compared to late planting.	Elhag and Ahmed, 2014
Tomato	Fruit size of early sowing was bigger (4.76 cm × 4.88 cm) than late sowing. October 1 seed sowing produced the highest marketable fruit yield (74.75 t/ha) against the lowest (24.60 t/ha) from October 30.	Hossain *et al*., 2014
Tomato	The plant was cultivated at different date of planting *viz*; September 15, September 30 and October 15. The yield attributing traits were significantly influenced by different planting dates and sources of nutrients Planting on September 15 recorded the highest plant height (254.95 cm),number of leaves per plant (33.47), fruits per plant (80.39), fruit length (6.75 cm), fruit girth (5.53 cm), mean fruit weight (124.26 g), yield per plant (10.39 kg), yield per plot (42.44 kg) and TSS (5.55 ºB) content over later date of planting.	Singh *et al*., 2015
Cucumber	The different time of planting, variety and their interactions showed significant effect on the growth of cucumber on number of fruits per plant, fruit length, fruit diameter, single fruit weight, fruit yield/plant and fruit	Longjam and Bijaya devi, 2017

	yield/ha .	
Oriental pickling melon	Crop planted during monthly intervals from August to February. August sowing recorded higher fruit weight and fruit yield per vine than the later sowings.	Nagendra *et al*., 2017
Tomato	Three sowing dates *i.e*. July 15, August, 15 and September, 15 were considered as factor A and tomato variety *viz*., Heemsona, Ranganga and Shikar were considered as factor B. The planting with 15^{th} September with Heemsona was founded better in respect of yield (77.74 t/ha) compared to 15^{th} July planting with Ranganga variety (16.66 t/ha). The number of fruits per plant was highest (308.87) with 15^{th} September planting in heemsona variety and lowest with 15th July planting in Shikar variety.	Cheena *et al*., 2018
Okra	The maximum number of fruit per plant (17.28), length of fruit at harvest (18.03 cm) and fresh fruit yield (83.44 qha^{-1}) were recorded under 20^{th} July sowing as compared to other sowing dates.	Chawla *et al*., 2018
Okra	The crop was planted at three planting dates (February 15^{th}, March 15^{th}, and April 15^{th}). Planting date significantly affects the fruit yield. The highest yield was found with April 15^{th}.	Gad-El Moula *et al*., 2018
Karchikai	The plants were sown at four dates *viz*. June 1^{st}, July 1^{st}, August 1^{st} and	Mahantesh *et al*., 2018

(*Momordica cymbalaria*)	September 1st. Planting date significantly influenced yield attributes. The tubers planting on June 1st recorded maximum average fruit weight (g) yield per plant (kg).	
Cucumber (Pusa Seedless Cucumber-6 variety)	The date of planting exhibited significant influence on yield and yield components of cucumber. The highest number of fruits (17.97), fruit weight (124.96 g), fruit diameter (3.26 cm), yield/plant (2264.3 g) and yield/1000 m^2 (150.96 q) was noticed in 15 September.	Maragal *et al*., 2018
Chilli	The crop were planted at three planting time *viz.*, 01 April, 15 April and 30 April. The 15 April planting date emerged as best in terms of maximum weighed fruit (2.661g), weight of fruits/ plant (409.3g), number of fruits/plant (182.5) and fresh yield (12.14 t/ha).	Ratna *et al*., 2018
Tomato	The sowing dates (1st, 15th and 30th January) and cultivars (Roma, Rio Grande and Red Stone) significantly affected the growth and yield parameters. Among different sowing dates 15th January significantly increased flower cluster $plant^{-1}$, number of fruit $cluster^{-1}$ and yield (26.3t ha^{-1}).	Ilyas *et al*., 2019
Spinach	The crop was sown four times at roughly 2-week intervals (mid-October, early November, mid-November, and early December). The two earliest sowing dates had higher total yield on average (288 and 294 g/ft^2, respectively) than the two later sowing dates (232 and 205 g/ft^2, respectively).	Heyduck *et al*., 2019

Musk melon	The plants were sown at five dates of planting *i.e.,* 5^{th} December, 15^{th} December, 25^{th} December, 5^{th} January and 15^{th} January. 15^{th} February recorded significantly maximum for fruit yield/plant (10.58 kg), weight of fruit (547.00 g), vine length (185.0 cm) and number of fruit /plant (19.36).	Ranjan *et al*., 2019

2.1.3 Seed yield attributes

Crop	Highlights of the experiment	Reference
Okra	Sowing okra in April was ideal for seed production as seed yield per plant and seed yield per hectare were highest (925.00 kg ha^{-1}).	Palaniswamy, 1979
Cauliflower	The month of April and May were ideal for seed production as seed yield, number of siliques per plant, silique length and 1000 seed weight were highest from these sowings.	Incalcaterra and Iapichino, 2000
Carrot	Sowing was done on four dates at fortnightly interval from August 15^{th} to October 1^{st}. September 1^{st} produced the highest number of umbels per plant, seeds per umbel, 1000 seed weight and seed yield per hectare.	Nadaf , 2007
Grain amaranth	Transplanting in *kharif* is optimum for seed production in grain amaranth when compared to summer season.	Manikandan, 2008
Carrot	Sowing was taken up in the months of November, December, January and February in Ethiopia. The number of umbels per plant, umbel diameter, seed	Mengistu and Yamoah, 2010

	yield per plant and seed yield per hectare were high in November sown crop.	
Cowpea	Five varieties of were sown in Nigeria consecutively for two years (2008 and 2009) at four different months of sowing (June, July, August and September). July and August sowing was the best to raise the seed crop.	Akande *et al.,* 2012
Cucurbita pepo L. (Summer Squash)	April 18th sown plants recorded the highest seed yield per unit area, number of seeds per fruit, number of fruits per plant and seed dry weight among the three sowings (April 18th, 29th and May 9th).	Latifi *et al.,* 2012
Okra	The crop raised in *kharif* (June) had higher seed yield per hectare (729.00 kg ha^{-1}) when compared to *rabi* (January) crop (706 kg ha^{-1}).	Karthika, 2013
Cabbage	Sowing was done on four different dates (October 1st, October 15th, November 1st and November 15th). Highest yield (net head weight) was recorded in November 1st sowing (519.03 g) followed by October 15th sowing (451.21 g). Sowing on November 1st resulted in early head formation and early head harvest.	Divya, 2013
Okra	The highest number of pods per plant and seeds per pod and seed yield per plant were obtained at early sowing (1st of July) compared to late sowing (20th of July and 10th of August).	Elhag and Ahmed, 2014
Cabbage	The crop was planted at fortnightly intervals from May 15th to July 30th. May	Kurian, 2014

	30th planting took the minimum number of days to reach 50 per cent head formation (47.50 days) which was on par with May 15th (48 days) planting. The highest net head weight was observed in May 15th (818.75 g) planting whereas, the lowest was recorded in June 15th (486.25 g) planting. May 15th planting also recorded the maximum value for head characters like head length (13.55 cm) and head breadth (15.73 cm).	
Bitter gourd	The crop was sown for six months continuously at monthly interval from October to March for three consecutive years from 2009 to 2011. The fruits per plant, seeds per fruit, 100 seed weight and seed yield per hectare were highest in February sown crop and the least was observed in October sown crop.	Rahman *et al.,* 2014
Amaranthus	The planting was done at bimonthly intervals starting from March 2013 to January 2014. Among the planting dates, March planting recorded the highest yield and yield attributes.	Shemon, 2014
Vegetable pea	Seeds were sown on three dates, *i.e.,* 1st, 15th and 30th August with six varieties (SP X VL-7, SP X DVP-1, Arkel, VL-7, PSM-3 and VL-10) during consecutive years (2009 and 2010). August first sowing recorded better pod length, pod diameter and seed yield.	Tiwari *et al.,* 2014
Cauliflower	October 1st sowing produced the maximum number of pods per plant, number	Hossain *et al.,* 2015

	of seeds per pod and seed yield among the planting dates (September 20th, October 1st, October 10th and 20th October).	
Onion	The seed setting percentage and seed yield per plant was highest for the first date of sowing (October 15th).	Kumar *et al.,* 2015
Okra	Sowing was done on three different dates (15th, 30th March and 14th April) where, the highest number of pods per plant, pod length, pod diameter, pod weight, pod yield, seed yield per hectare and 1000 seed weight was observed in 30th March sowing for the six cultivars ((Irka, SabzPari, Pusa Green, PusaSawani, Sarhad Green and Green Star).	Shahid *et al.,* 2015
Cucumber	The seed yield per plant and seed yield per hectare were high in the crop sown on 1st March, while it was least in the crop sown on April 30th.	Singh *et al*., 2015
Broccoli	Seedlings raised by sowing on four different dates *viz.* 10th October, 30th October, 20th November and 10th December. Yield and yield attributing characters were significantly influenced by sowing dates. Sowing on 10th October produced the highest head yield (137.81q/ha) while 10th December sowing produced the lowest head yield (6.75 q/ha) of broccoli.	Gogoi *et al*., 2016
Oriental pickling melon	August sowing recorded the highest number of seeds per fruit, fresh and dry weight while 100 seed weight was not much affected by environmental	Nagendra *et al*., 2017

	conditions.	
Okra	The plant were sown at four times *viz*., 2nd week of June, 4th week of June, 2nd week of July and 4th week of July. Maximum seed yield per plant (69.80 g) was recorded in second week of June sown crop. The highest seed yield (18.61q) per hectare was observed in second week of June sown crop, which proved to be statistically superior over all other sowing dates. The second week of June had the highest test weight (64.31 g) and was found to be significantly superior over other sowing dates.	Singh *et al*., 2018
Onion	Planting time was significantly influenced onion seed yield and seed yield-related parameters such as umbel diameter, number of seeds per umbel, 1000-seed weight, seed yield per plant and seed yield per hectare. The highest seed yield (1032.7 kg/ha) recorded from bulb planted late (December).	Tesfaye *et al*., 2018

2.1.4 Vivipary

Seeds in fruits do not generally germinate while remaining in the fruits, even at full maturity. Vivipary is the phenomenon that involves seeds germinating prematurely while they are still inside or attached to the parent plant or fruit and is characterized by the lack of seed dormancy.

In vivipary, the embryos consistently develop yet the seeds germinate within the fruit before they are detached from the parent plant (Aragon-Gastelum *et al.,* 2013). It is a remarkable condition because of its rarity and the complex ecophysiological processes involved in the control of seed germination.

Two types of vivipary are known in plants: true vivipary, or generative vivipary, and pseudo vivipary, or vegetative vivipary. These unusual conditions occur in less than 100 angiosperm plant families including 140 genera and 200 species. Of these, 70 species are viviparous and 45 are pseudo viviparous (Cota-Sanchez *et al*., 2011). Cryptovivipary is a subcategory of true vivipary in which the seedlings are concealed within the fruit and do not protrude through the pericarp. This condition is exhibited by Aegiceras, Avicennia and Nypa species. Vivipary is a common phenomenon noticed in all species of the family Rhizophoraceae (Tomlinson and Cox, 2000), all species of *Avicennia* sp. and *Aegicer ascorniculatum* (Göltenboth and Schoppe*,* 2006*).*

Several investigators have reported these phenomena in tomato (Dos Santos and Yamaguchi, 1979; Yamaguchi *et al*., 1967), bell pepper (Harrington, 1960; Marrush *et al.,* 1998), watermelon fruits (Kobayashi *et al*., 2010), maize (Eyster, 1931), chayote (Aung *et al.* 1990), over-ripe tomato *sitiens* mutant (Groot and Karssen, 1992), Chinese cabbage (Ren and Bewley, 1998, 1999), rice (Miyoshi *et al.,* 2000), lemon, orange, rape, and coconut, *Hedychium sp.* (Ashokan *et al*., 2018). The mechanism of precocious germination varies between species.

Vivipary mechanism is common in mangrove plants. Seeds of some mangroves use this mechanism thus do not enter dormancy nor desiccation, which is an adaptive feature to withstand the hostile environment and expand their populations at coastal tropical habitats (Hong *et al*., 2018). Vivipary in mangroves is a genetically programed process and it happens regardless the acute environmental conditions. This is in stark contrast to other viviparous germination of Arabidopsis, maize and rice *etc*. where precocious germinations largely depend on the environmental conditions (high humidity and/or high temperature) or genetic mutations.

Saran *et al*. (2014) screened fourteen genotypes of papaya and noticed that incidence of vivipary was highest in the crop sown in the May (13.4%) and least was observed in the February (10%) and March (5%) month of planting. Wang *et al.* (2016) observed a tomato mutant exhibiting viviparous fruits and highlighted that the reason behind the viviparous nature was hypo-osmolality or hormonal imbalance.

Nagendra *et al*. (2017) reported the occurrence of vivipary in oriental pickling melon variety, Saubhagya during December (6.25%), January (3.60), February (1.44%) and September (1.47%) month of sowing. The occurrence of vivipary was highest during the month of December.

2.2 Impact of application of different potassium nutrient levels on flowering, fruit and seed yield attributes

2.2.1 Flowering and Fruit yield characters

Potassium (K^+) is a crucial nutrient element for higher plants and plays vital roles in several cellular processes including turgor regulation, stomatal movement, protein synthesis and charge balance. The requirement of K^+ for plant growth changes with the developmental stages and its uptake pattern varies among crop plants.

Adequate K nutrition has also been linked with increased yields addressed by Lester *et al*. (2005) and Kanai *et al*. (2007) which further confirm our findings that foliar application of K with 0.5–0.7% has markedly increased yield of tomatoes. Fruit quality is directly affected by potassium supply (Lester *et al*.. 2005). If soil-applied fertilizer K was compared to foliar K applications, the second approach consistently resulted in improved number of fruits and quality attributes (Afzal *et al*., 2015). The beneficial effects of supplemental K probably resulted from a combination of improved leaf photosynthetic CO_2 assimilation, assimilate translocation from leaves to fruits, improved leaf and fruit water relations, increased enzyme activation and substrate availability for ascorbic acid and β-carotene biosynthesis all associated with adequate K nutrition (Gross, 1991).

The mean number of female flowers, number of fruits and seed yields were significantly affected by the applied N and K fertilizers (Olaniyi and Tella, 2011). Asao *et al*. (2013) reported that no significant effects of reduced KNO_3 in the culture solution was observed on the growth variables, yield and fruit qualities of melon. The effects of potassium application on tomato yield and yield components were statistically significant. The value of fruit number per plant ranged from 29.20 to 34.57 and fruit weight from 160.45 to 185.63 g (Çolpan and Zengin, 2013).

Foliar application with varying levels (0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9 and 1.0%) of potassium solutions was applied on two tomato cultivars, Nagina and Roma and compared with control (without K). Exogenous application of 0.6% K significantly improved plant height, lycopene content, potassium, fruit weight and diameter. Due to positive correlation between K nutrition and fruit quality attributes, exogenous application of an appropriate K level can contribute to higher yield and better quality of tomato fruits (Afzal *et al*., 2015).

The improvement of growth and yield attributing characters were associated with enhancement of potassium level in plant due to foliar application of K (Sarma *et al*., 2015).

Potassium nitrate (KNO_3) and mono potassium phosphate (MPK) at different concentrations were applied through spraying on the trees either pre or post bloom. Results showed that all treatments of potassium nitrate (KNO_3) or mono potassium phosphate (MPK) caused a remarketed promotion in leaf mineral status, yield and fruit quality compared with the control trees. The best results with regard to foliar application were obtained with KNO_3 at 3% concentration which superior to improve nutritional status, flowering, fruit set, yield and fruit quality (Sarrwy *et al*., 2010).

The significant effect of K application on fruit weight was reported by several workers (Woldemariam, 2017 and Correa *et al*., 2018). They conclude that adequate K increases fruit weight by increasing translocation of photosynthates to fruit and water use efficiency. Ramadan and Shalaby (2016) indicated that the foliar application of K resulted in an increased growth and yield of eggplants grown under conditions of salt stress.

Crop	K application	Attributes improved	Reference
Cucumber	Foilar (KCl)	Quality, disease tolerance	Magan *et al*., 2003
Cucumber	Soil (K_2SO_4, KCl)	Amino acids, quality	Guo *et al*., 2004
Musk melon	Soil	Yield	Demiral and Koseoglu 2005
Muskmelon	Foliar (Gly-amino-K)	Yield, marketable fruit	Lester *et al*., 2010 Jifon and Lester, 2009
Okra	Soil	Firmness, shelf-life, reduced cracking	Zhang *et al*. 2008

Pepper	Soil (K_2SO_4)	Quality, yield and weight	Ananthi *et al*. 2004 Golcz *et al*. 2004
Tomato	Soil (K_2SO_4)	Yield	Hewedy, 2000
Tomato	Fertigation / soilless (K_2SO_4)	Yield	Chapagain and Wiesman, 2004
Vegetables	Soil (K_2SO_4)	Dry weight	Ni *et al*. 2001

2.2.2 Seed yield attributes

Seed and seedling traits are affected by the conditions of the maternal environment, such as light, temperature, and nutrient availability (Geshnizjani *et al*., 2019).

The seed production was evidently affected by different nutrient supply. The number of pods and the number of seed per pod in *Capsella bursa-pastoris* varied with variation of nutrient supply. The increase in the number of branches per plant, the number of seeds per individual stem, the number of pods and the number of seeds per pod were all contributed to the increase of seed production (Yang, 2018).

Olaniyi and Tellan (2011) reported that seed yield was influenced by the increased rates of potassium application up to 30 kg K_2O ha^{-1} and declined at 40 kg K_2O ha^{-1}. Increased of applied K from 60 to 90 kg ha^{-1} and 90 to 120 kg ha^{-1} showed no significant increase in seedyield in spring canola (Govahi and Saffari**,** 2006).

2.2.3 Vivipary

Yamaguchi *et al*. (1967) reported that viviparous sprouting may be the result of excess nitrate nitrogen while Dos Santos and Yamaguchi (1979) and Marrush *et al*. (1998) reported that it might be due to depleted potassium. Ochi and Ito (2012 a, b) concluded that a high nitrate nitrogen level or lower potassium fertilization might lead to a decrease in the ABA content in fruit juice samples around the placenta, resulting in the increased occurrence of viviparous sprouting. In particular, low potassium fertilization was the leading factor in the increased occurrence of viviparous sprouting.

ABA level in plant is also related to the occurrence of vivipary. Increased ABA level in the plant enhanced potassium absorption in cucumber under high temperature conditions and exogenous ABA application increased the fruit weight and Brix of melon. High Brix is related to high osmotic pressure, and thus might lead to a decreased occurrence of viviparous sprouting in melon fruit (Du and Tachibana, 1995; Kamuro *et al.*, 1992 and Welbaum, 1999).

Ochi *et al*., (2013) demonstrated that high potassium fertilization markedly decreased the occurrence of viviparous sprouting, probably due to the increase of the endogenous ABA content. Thus, side-dressing of potassium fertilizer after pollination may enable the reduction of the occurrence of viviparous sprouting in practical seed production of melon. In seed production, nutritional conditions after pollination are important to enhance seed yield and quality. They also concluded that ABA application increased the ABA content and the decreased occurrence of viviparous sprouting. It also suggested that ABA application may retard embryo development or might extend seed dormancy, leading to the inactivation of seed germination.

Alteration in genetic constitution resulted in viviparous nature in maize (Eyster, 1924 a). Dubey *et al.* (2011) noticed vivipary in few sesame pods and stated that the viviparous nature of some pods is due to altering of phytohormones by some seed borne fungi.The first report of vivipary (precocious germination) in *Saussurea lappa*, seemingly induced by excessive humidity resulting in limited seed production.(Chauhan *et al*., 2018)

Kobayashi *et al*. (2010) reported the existence of chemical factors that inhibit viviparous seed germination of watermelon. Several evolutionary and ecological theories have been used to explain the prevalence and implications of this reproductive mechanism in plants, from facilitating seedling establishment to provide new avenues for offspring survival and dispersal, protecting the embryo from extreme saline concentrations and environmental stress (Cota-Sanchez, 2018).

2.2.4 Potassium uptake by fruits

Potassium (K+) is a crucial nutrient element for higher plants and plays vital roles in several cellular processes including turgor regulation, stomatal movement, protein synthesis and charge balance. It stands out as a cation having the strongest influence on quality attributes that determine fruit marketability, consumer preference, and the concentration of critically important human-health associated phytonutrients. The timely, optimum supply of K^+ is helpful in developing plant resistance to various stresses such as drought, salinity, cold damage and lodging. Plants absorb more K than any other mineral element with the exception of Nitrogen. Potassium plays the most important role in fruit quality and flavor.

Potassium uptake by plants from soil solution is influenced by several factors, including soil moisture conditions, pH, texture, aeration, temperature, and balance with other nutrients. Plant development stage also influences the capacity for K uptake. More K is taken up during the vegetative growth stages when roots are actively growing than in fruit growth (reproductive) stages when root growth is inactive (Beringer *et al*., 1986).

Foliar K application generally resulted in higher K concentrations in fruit mesocarp (edible pulp) tissue and fruit K contents resulting from the supplemental foliar application, increased with weekly applications of potassium (Jifon and Lester, 2009). At fruit maturity, tissue (leaf, petiole, stem and fruit) K concentrations of foliar K-treated plants were on average ~19% higher than those of control plants (Hochmuth and Hanlon, 1995)

Hernandez-Gomez *et al*. (2013) verified that the cultivation of peppers with high concentrations of NH_4^+ was possible to maintain plant productivity, increasing the K concentration of nutrient solution, which resulted in adequate K contents in the plant tissue.

Adequate potassium nutrition must occur from the acquisition of seeds because nutritional status of mother plant affects not only the final yield of crop but also the quality of seeds produced (Cruz *et al.,* 2019). The deficiency of K in mother plant, during the phenological stage of seed formation, may decrease the germination rate of harvested seeds (Hejcman, 2012). However, the seeds of plants well-nourished with K may present the germination rate due to the accompanying ion of the source of K used, because of a negative correlation between germination percentage and concentration of Cl in sweet pepper seeds (Xu *et al*., 2002)

Skogley and Haby (1981) found that increasing soil moisture from 10 to 28 per cent more than doubled total soil K transport. Therefore, soil moisture deficits can limit soil K transport as well as uptake into the plant, thereby causing K deficiency. A general trend of decreasing K content in fruit was observed with the decrease of KNO_3 concentration in nutrient solution without significant decline in fruit yield (Asao *et al*., 2013).

2.3 Impact of storage period and different potassium nutrient levels during crop growth on seed quality and longevity

Seed is a living entity and is subjected to various environmental stresses which affect the quality. In storage, the viability and vigour of the seeds not only vary from genera to genera and variety to variety, but it also regulated by many physico-chemical factors like moisture content, atmospheric relative humidity, temperature, initial seed quality, physical and chemical composition of seed, gaseous exchange, storage structure, packaging materials, *etc*. Among these, the major factors affecting the seed quality during storage are temperature and relative humidity, which results in drastic deterioration of seed. Apart from this, fungi associated with stored seeds are mainly responsible for deterioration of quality and reduction in germination potential (Chormule *et al*., 2018). Seed and seedling traits are also affected by the conditions of the maternal environment, such as light, temperature, and nutrient availability (Geshnizjani, 2019).

Phases of storage starts from storing from harvest to packaging and till the distribution of the packed products. It is followed by in-transit storage and on-farm storage until planting in field. Thus the storage chapter of seeds starts from the field itself from physiological maturity to harvest.

The modified viability equation given by Ellis and Roberts (1980) explains the interrelation between temperature, seed moisture and viability. It provides understanding regarding the behaviour of seed populations at different sets of temperature and moisture content. According to Ellis *et al.* (1985), loss of seed quality, viability and vigour is either due to ageing or the effect of adverse environment. Many studies are carried out to know the effect of environmental conditions on seed storage.

Among the environmental conditions, fertilizer has the potential to determine seed quality, including germinability, dormancy, size and composition (Fenner, 1991). It has been reported that the maternal nutrient effect can affect the subsequent performance of offspring and seed germination (Hrdličková *et al*., 2011). Production, size, and germination of broad-leaved dock seeds collected from mother plants grown under different nitrogen, phosphorus, and potassium supplies also show significant effect in different *Plantago* species (Miao, *et al*., 1991). In relation to the production of *Brassica oleracea* seedlings, Zhang *et al*. (2017) have demonstrated that although it depends on a relationship with other nutrients, the enrichment of substrate with K provides more vigorous seedlings.

Influence of phosphorus and potassium supply to the mother plant on seed yield, quality and vigour in pea was reported by Amjad *et al*., 2004. Effect of nitrogen, phosphorus and potassium availability on mother plant size, seed production and germination ability of *Rumex crispus* was also reported (Hejcman *et al*., 2012).

Nutrient levels showed significant influence on the seedling length of harvested seeds was reported by Hunje (2019). Electrical conductivity values were significantly varying with nutrient treatments given during crop growth. Similar findings were quoted by Basavaraj *et al*. (2008) in onion at the end of six months of storage and Manjunath *et al*. (2008) in chilli stored for 12 months.

The effect of nutrient levels on time taken for 50 % germination was found to be non-significant over the storage while Amjad *et al*. (2004) indicated highly significant results.

Seed quality parameters decline with the progressive increase in storage period. The marked decrease in the seed quality parameters under advancing storage period may be attributed to seed coat characters (Delouhe *et al*., 1973), age induced physicochemical seed deterioration, lipid peroxidation leading to production of toxic metabolites that act upon cell and cell organelles (Sohal, 1987), denaturation of proteins and enzymes (Roberts, 1972).

The seed quality parameters like germination per cent, seedling length, seedling vigour index- I and II decreased with prolonged storage. Similar studies were demonstrated by Manjunath *et al*. (2008) in chilli stored for 12 months; Alhamdan *et al*. (2011) in cucumber, onion, carrot and tomato seeds, Navya (2016) and Sandhya (2016) in chilli, Shobha (2016) and Athmaja *et al*. (2018) in ash gourd, Nagendra *et al*. (2017) and Reshma (2018) in oriental pickling melon.

Nagendra *et al*. (2017) studied the effect of storage of oriental pickling melon for six months and concluded that the germination per cent, seedling vigour decreases with progressive increase in storage period while the electrical conductivity of seed leachate increases with increase in storage period.

Anitha (1997) concluded that the storage environment had no significant effect on seedling length. Under ambient conditions ash gourd seeds retained minimum standard of seed germination for six months (Sakthivel, 2003) whereas in bitter gourd, seeds could retain germination for about three months under ambient conditions (Abila, 2008).

Seeds of snake gourd varieties *viz*., Baby and Kaumudi were stored under ambient and cold storage conditions to study the effect of storage environment on seed quality. Highest germination, seedling length and vigour were obtained upto third month of storage under ambient conditions and four months under cold storage conditions. Electrical conductivity of the seed leachate values was found to increase with increase in storage period (Dhobi, 2012).

The decline in seedling length was observed with the advancement of storage period which results in reduction of seed vigour due to seed aging process. Similar results to the present study was reported by Aswathi (2015) in cowpea.

Electrical conductivity (EC) test is a measure of the integrity of cell membrane. The increase in electrical conductivity values with the increase in storage period was attributed to membrane aberrations of seeds. It has been well correlated with plant vigour and field emergence in some crops. As deterioration occurs, the seed membrane degrades and it causes seeds to exude electrolytes such as amino acids, organic acids and sugar. The principle of the EC test is that less vigourous or more deteriorated seeds show a lower speed of cell-membrane repair during seed water uptake for germination and therefore release greater amounts of solutes to the external environment (Marcos-Filho, 2015).

Good quality seeds as well as treated seeds are able to retain membrane integrity for longer period and hence recorded lower values of electrical conductivity from the seed leachates. Similar findings are reported by Navya

(2016) and Sandhaya in chilli, Shobha (2016) and Athmaja *et al*. (2018) in ash gourd and Nagendra *et al.,* (2017) in oriental pickling melon.

2.4 Seed health during storage

Seed health is a well-recognized factor in the modern agricultural science for desired plant population and good harvest (Rahman *et al*., 2008). Seedborne pathogens are a continuing problem and may even be responsible for the re-emergence of diseases of the past as well as the introduction of diseases into new areas and it is a serious threat to seedling establishment. The quality of planted seeds has a critical influence on the ability of crops to become established and to realize their full potential of yield and value (McGee, 1995).

Seed-borne fungi are one of the most important biotic constrains in seed production worldwide. Of the 16 per cent annual crop losses due to plant diseases, at least 10% loss occurs due to seed-borne diseases (Fakir, 1983). They are responsible for both pre and post-emergence death of grains, affect seedling vigour, and thus cause some reduction in germination and also variation in plant morphology. The seedborne pathogens may result in loss in germination, discolouration and shriveling, biochemical changes such as change in physico - chemical properties of seed, development of plant diseases, distribution of pathogen to new areas, introduction of new strains or physiologic races of the pathogen along with new germplasm from other countries and toxin production in infected seed. Fungi outnumber all other types of pathogens that attack plants and cause a very serious economic impact on agricultural production due to their ability to induce diseases of cultivated crops that result in important yield losses.

Several workers reported the involvement of fungal infection in seed aging. Fungal infected seeds deteriorate faster than uninfected seeds in storage were reported by Christensen and Kaufman (1969), Christensen (1967, 1972 and 1973), and Neergard (1977). Cucurbit plants are commonly exposed to attack by many serious seed borne pathogens as well as soil borne pathogens. The bad effect of seed-borne pathogens of cucurbits not only include reduction of yield but also concerns with the transmission of the pathogens from a season to another and from one field in a country to other fields in other countries. Seed microflora infection per cent increase over the period of storage and highest incidence of fungus observed in storage are *Aspergillus flavus* and *Aspergillus niger* (Navya, 2016; Sandhya, 2016; Shobha, 2016; Antony, 2016 and Nagendra, 2017). Some of the seed borne pathogen infecting the vegetable seeds is enlisted below.

Crop	Seed borne pathogen	Reference
Bottle gourd Sponge gourd	*Fusarium solani*	Shakir *et al*., 1992; 1995; Wahid, 1985 and Wahid *et al*., 1991
Water melon Sponge gourd	*Fusarium oxysporum*	Mclaughlin and Martyn, 1982 Shakir *et al*., 1995
Amaranth	**Blotter test** - *Aspergillus flavus*, *A. niger* (7.50%) and *Alternaria* sp. (2.00%).	Mohanto *et al*., 2019
Spinach	**Blotter test** - *Aspergillus flavus*, *A. niger* (8.00%) and *Alternaria* sp. (2.25%).	
Bottle gourd	**Blotter test** - *Aspergillus flavus*, *A. niger* (8.00%) and *Alternaria* sp. (2.75%).	
Sweet gourd	*Aspergillus niger, Chaetomium* sp. (9.00%), *Fusarium* sp. *and Alternaria* sp. (4.25%)	
Bitter gourd	**Blotter test** – *Chaetomium* sp. (9.00%) and *Fusarium* sp. (3.00%)	
Cucumber	**Blotter test** – *Rhizopus* sp. (6.75%) and *Alternaria* sp. (3.00%)	
Snake gourd	**Blotter test** – *Aspergillus flavus,* Chaetomium sp. (8.50%) and Fusarium sp. (2.50%)	
Okra	**Blotter test** - *Aspergillus flavus* (9.00%) and	

	Alternaria sp. (3.50%)	
Brinjal	**Blotter test** - *Aspergillus flavus* (6.75%) and *Alternaria sp*. (3.50%)	
Country bean	**Blotter test** – *Aspergillus niger* (8.50%) and *Alternaria sp*. (3.75%)	
Sweet gourd White gourd Bitter gourd	**Blotter test** – *Aspergillus flavus* and *Penicillium*	Begum and Momin, 2000
Bitter gourd	*Altarnaria alternata*, *Aspergillus flavus*, *A. niger*, *Fusarium solani*, *Myrothecium roridum* and *Rhizopous spp.*	Chauhan and Geeta, 2011
Cucumber	*Fusarium* spp. (4.75%),*Curvularia* spp. (3.75%) and *Penicillum* spp. (2.00%)	Begum and Momin, 2000; Alimova *et al*. 2002; Islam, 2005; Hamim *et al*., 2014
Cucurbits	*Fusarium solani, Aspergillus niger, Cladosporium* sp., *Sclerotinia sclerotiorum,* and *Aspergillus* spp.	Abushaala *et al*., 2016
Cucumber	*Alternaria* spp., *Curvularia* spp., *Fusarium* spp. and *Penicillium* spp.	Chowdhury *et al*., 2005; Alimova *et al*., 2002; Nasreen and Sultana, 2000; Puspa *et al*., 1999

Materials and Methods

3. MATERIALS AND METHODS

The present investigation on 'Potassium nutrition on vivipary and seed quality in oriental pickling melon (*Cucumis melo* var. *conomon* Mak.)' was carried out at the Department of Seed Science and Technology, College of Horticulture, Vellanikkara, Kerala Agricultural University (KAU), Thrissur during the year 2017 – 2019. The study was undertaken with the objective of assessing the effectiveness of various levels of potassium vivipary in oriental pickling melon and to elucidate its effect on seed quality during storage. The insights about the materials and techniques that have been utilized for the research work are described below.

3.1 Location and climate

The experimental site is located at an altitude of 40 m above MSL at 10°54' N latitude and 76°28' E longitudes. The area experiences a warm humid tropical climate. The field experiment and storage studies were conducted at the Department of Seed Science and Technology, College of Horticulture. The monthly mean maximum temperatures varied from 35.7^{0}C (February, 2018) to 34.6^{0}C (May, 2019), while the mean minimum temperatures ranged between 22.5^{0}C (February, 2018) and 24.9^{0}C (May, 2019). During the study period the relative humidity varied between 47 per cent (February, 2018) and 74 per cent (May, 2019), while rainfall ranged between 5.2 mm/cm/litre (February, 2018) and 48.8 mm/cm/litre (May, 2019). The meteorological data recorded during the research period is presented in Table 1.

3.2 Soil

The experimental field has sandy clay loam type of soil. The characteristics of soil in the experimental field were analysed as per the methods listed in Table 2. The soil characteristics of the experimental field are presented in Table 3. From the table, it is evident that potassium in soil was high whereas this experiment was carried out to standardize the effect of potassium on vivipary on Kerala conditions as per POP.

Table 1: Monthly meteorological data from February 2018 to May 2019

Month	Surface air temperature (°c)		Mean Relative Humidity (%)	Rainfall (mm)	Rainy days	Mean Sunshine (hrs)	Wind speed (kmph)
	Mean maximum temperature (°c)	Mean minimum temperature (°c)					
February- 2018	35.7	22.5	47	5.2	1	9.5	5.7
March - 2018	36.7	24.0	59	33.2	2	8.0	3.3
April -2018	36.1	24.8	69	28.9	2	7.3	2.0
May - 2018	33.2	22.6	79	483.6	14	4.8	1.8
June - 2018	29.8	23.2	89	730.0	23	1.7	1.5
July - 2018	29.6	22.5	88	793.2	22	1.9	1.7
August - 2018	29.2	22.2	87	928.0	21	2.2	1.8
September - 2018	32.2	22.5	75	29.0	1	7.2	1.7
October - 2018	32.8	22.9	76	393.0	13	5.7	2.0
November - 2018	32.7	23.3	68	66.6	5	6.9	4.3
December – 2018	33.0	22.5	63	0.0	0	6.9	4.7
January – 2019	32.9	20.4	55	0.0	0	8.4	6.5
February – 2019	35.3	23.4	59	0.0	0	8.7	5.1
March – 2019	36.7	24.8	65	0.0	0	8.6	2.9
April – 2019	36.2	25.5	70	76.4	3	8.0	2.3
May - 2019	34.6	24.9	74	48.8	4	6.8	2.0

Table 2: Methods used for soil analysis

S.No.	Property	Procedure adopted
1	Texture	Robinson's International pipette method (Piper, 1950)
2	Soil reaction (pH)	1:2.5 soil: water suspension using pH meter (Jackson, 1973)
3	Electrical conductivity(dSm^{-1})	Supernatant of 1:2.5 soil: water suspension using EC metre (Jackson, 1973)
4	Available Nitrogen (kg ha^{-1})	Alkaline permanganate method (Subbiah and Asija ,1956)
5	Available Phosphorus (kg ha^{-1})	Bray and Kurtz method (Bray and Kurtz, 1947)
6	Available Potassium (kg ha^{-1})	Neutral normal ammonium acetate extract using Flame photometer (Jackson,1958)
7	Organic carbon (%)	Chromic acid wet digestion method (Walkley and Black, 1934)

Table 3: Soil characteristics of experimental field

Particulars	Value	Rating
Texture	Sandy clay loam	
Soil reaction (pH)	5.42	Strongly acidic
Electrical conductivity(μScm^{-1})	0.14	Low
Organic carbon (%)	1.40	High
Available Nitrogen (kg ha^{-1})	50.40	Low

Available Phosphorus (kg ha^{-1})	21.20	Medium
Available Potassium (kg ha^{-1})	339.36	High

3.3 Experimental material

Freshly harvested seeds of oriental pickling melon varieties, Saubhagya and Mudicode collected from Agricultural Research Station, Mannuthy and Department of Olericulture, College of Horticulture, Vellanikkara respectively were used for the research work. Details of genotypes used for study were presented in Table 4.

Table 4: Details of genotypes used for study

Genotypes	Description
Saubhagya	Parentage :- Selection from local collection from Valakkavu Special features:- High yield, small to medium sized oblong fruits Year of release :- 1998
Mudicode	Parentage :- Single plant selection from CS 26 Special features:- Large sized, long and oval-shaped golden yellow colour fruits with good flesh thickness Year of release :- 1998

3.4 Experimental details

The research work comprised of three experiments:

Experiment I: Effect of time of planting on vivipary (Season: December 2018 to February 2019

Experiment II: Effect of potassium levels on vivipary (Season: February 2018)

Experiment III: Seed storage studies (June 2018 to November 2018)

3.4.1 Experiment I

Effect of time of planting on vivipary in oriental pickling melon

3.4.1.1 Layout

The experiment layout is given in Fig. 1. The details of the experiment are mentioned below:

Design	: Factorial Randomized Block Design (FRBD)
Replications	: 4
Number of treatments	: 6
Varieties	: 2
Total number of plots	: 24
Plot size	: 5 m X 2 m
Spacing	:1.0 m X 0.3 m
	(HDP as per Ashley, 2016)
Number of plants per plot	: 20

3.4.1.2 Treatments

The treatment consists of three sowing dates and two varieties i.e., Saubhagya and Mudicode. The details are presented below.

T_1: Sowing on 1st fortnight of December

T_2: Sowing on 1st fortnight of January

T_3: Sowing on 1st fortnight of February

3.4.2 Experiment II

Effect of potassium levels on vivipary in oriental pickling melon

3.4.2.1 Layout

The experiment layout is given in Fig. 2. The details of the experiment are listed below:

Design	: Factorial Randomized Block Design (FRBD)
Replications	: 3
Number of treatments	: 12
Varieties	: 2
Total number of plots	: 24
Plot size	: 5 m X 2 m
Spacing	: 1.0 m X 0.3 m (HDP as per Ashley, 2016)
Number of plants per plot	: 20

3.4.2.2 Treatments

Different levels of potassium were given to study its effect on vivipary. Different manurial practices are mentioned below.

T_1: Control: POP (70:25:25)

T_2: No K (70:25:0)

T_3: 70:25:37.5 (25% additional K)

T_4: 70:25:50 (50% additional K)

T_5: POP + foliar spray (0.5% MOP at 50% flowering and two weeks after flowering)

T_6: Organic POP (Organic manures (Vermicompost @ 4t/ha) applied in 2 splits at vining and flowering stage and fresh cow dung slurry @ 1 kg/litre of water at fortnightly intervals starting from flowering)

*In the treatments T_1, T_3, T_4 and T_5, FYM was applied @ 20-25 t ha^{-1} as basal dose along with half dose of N (35 kg ha^{-1}) and full dose of P_2O_5 (25 kg ha^{-1}) and K_2O (25 kg ha^{-1}). The remaining full dose of N (35 kg ha^{-1}) are applied in two equal splits at the time of vining and at the time of full blooming. In T_2, same manurial practice was carried out but without the application of K_2O. In T_3, in addition to 25 kg ha^{-1} potassium, 6.25 kg ha^{-1} was applied as basal dose whereas in T_4, 12.25 kg ha^{-1} was applied.

Plate 1: General view of experimental plot- I

Plate 2: General view of experimental plot- II

3.4.3 Biometric observations

To know the effect of time of planting and different levels of potassium on vivipary and its effect on the growth and development of crop, growth and yield attributes as well as their component characters were noted. The observations were recorded on five randomly selected (tagged) plants of each replication (experimental unit) and the average was calculated. The details of the observations are as under:-

3.4.3.1 Days to appearance of first male flower

The number of days taken from the date of sowing to the emergence of first male flower was counted from the five tagged plants and recorded.

3.4.3.2 Days to appearance of first female flower

The number of days taken from the date of sowing to the emergence of first female flower was counted from the five tagged plants and recorded.

3.4.3.3 Fruit length (cm)

Fruit length was measured as the distance from proximal end to the distal end of the fruit. The fruit length of all fruits from five plants of each replication was measured using a metre scale and the average fruit length was recorded in centimetres.

3.4.3.4 Fruit girth (cm)

Fruit girth was measured as the circumference, at the middle of the fruit using a measuring tape from five tagged plants in each replication and average girth was worked out in centimetres.

3.4.3.5 Fruit diameter (cm)

Diameter at the middle of the fruit was recorded for five plants in each replication and the average fruit diameter was expressed in centimetre.

3.4.3.6 Fruit weight (g)

Weight of fruits per five tagged plants of each replication was recorded using a weighing balance and the average fruit weight was computed in grams.

3.4.3.7 Fruit yield per vine (kg)

Total number of fruits produced per vine at each harvest was recorded from the five tagged plants and the average yield of fruits per vine is expressed in kilogram.

3.4.3.8 K content in fruit placenta (%)

Fruits were collected at the time of the harvest from all the treatments. Then the placenta and flesh were separated from individual fruits and weighed to 0.2 g. It was then digested using nitric acid and perchloric acid (9:7) until a clear solution was formed. The solution was made upto 100 ml using distilled water in a volumetric flask. It was then filtered and a 5 ml aliquot was taken and the volume made upto 100 ml in a volumetric flask. The K_2O content in the solution was determined in a systronics flame photometer (Bhargava and Raghupathi, 1993). The potassium content of fruit placenta was estimated and expressed in per cent.

3.4.3.9 K content in flesh of fruits (%)

The potassium content of flesh of the fruit was analysed as per 3.5.3.8 and was expressed in per cent (Bhargava and Raghupathi, 1993).

3.4.3.10 Seeds per fruit

Number of seeds per fruit was recorded by carefully separating the seeds from individual fruits and counted using the seed counter (Waver make and model IC-VA) machine. The average number of seeds per fruit was worked out.

3.4.3.11 Fresh weight of seeds per fruit (g)

Fresh weight of seeds per fruit was recorded using digital weighing balance and the average was computed in grams.

3.4.3.12 Vivipary (%)

Per cent vivipary was estimated as detailed below. The average was recorded in per cent.

$$\text{Vivipary (\%)} = \frac{\text{Number of viviparous seeds per fruit} \times 100}{\text{Number of seeds per fruit}}$$

3.4.3.13 Chaffy seeds (%)

Chaffy seeds were separated from each fruit using seed blower (Dakota type) and the weight was recorded. The average was computed in per cent.

$$\text{Chaffy seeds (\%)} = \frac{\text{Weight of chaffy seeds}}{\text{Weight of seeds per fruit}} \times 100$$

3.4.3.14 Dry weight of seeds per fruit (g)

Dry weight of seeds per fruit was recorded after drying the seeds to a moisture content less than 8 per cent and the average was noted in grams.

3.4.3.15 100 seed weight (g)

Hundred seeds were weighed randomly from each seed lot and the average was expressed in grams (Anon, 1999).

3.4.3.16 Seed yield (kg/ha)

Seed yield per vine was recorded from each replication of all the treatments and it was computed as seed weight per plot and expressed in kilograms. The seed yield per hectare was computed.

3.4.4 Experiment III

Seed storage studies

3.4.4.1 Experiment material

Seeds collected from twelve treatments under Experiment II were collected individually and dried to a moisture content less than 8 per cent, packed in 700 gauge polyethylene bag and stored under ambient conditions for six months. Samples were drawn at monthly intervals and various parameters were analysed.

3.4.4.2 Experimental details

The details of the experiment are listed below:

Design	: Factorial Completely Randomized Block Design (FCRD)
Replications	: 3
Number of treatments	: 12 (Combining 2 varieties and 6 manurial practices)
Varieties	: 2

3.4.4.4 Observations

Seed quality parameters such as seed germination (%), shoot length (cm), root length (cm), dry weight of seedling (g), electrical conductivity (EC) of seed leachate ($\mu S/cm^{-1}$), mean germination time (MGT), time taken for 50% germination (T_{50}) and seedling vigour index were recorded during monthly intervals by randomly selecting the seeds from each seed lot of various treatments. Seed micro flora (%) and seed moisture (%) were noted during the start and end of the storage study. The standard procedures for determining the quality parameters of seed are enumerated below.

3.4.4.4.1 Germination (%)

Four replications of hundred seeds were randomly drawn from each treatment along with properly graded and sterilized sand substrata are used for the germination test. The germination was carried out as per the ISTA (1986) rules and maintained for a prescribed time period in a germination room at 25 ± 2°C temperature and 96 ± 2% RH. Moist the sand whenever required and number of seeds germinated at first and final count was recorded, i.e. on the 4^{th} and 10^{th} day.

The germination per cent was estimated as below and average percent was calculated to the nearest whole number.

$$\text{Germination (\%)} = \frac{\text{Number of seeds germinated}}{\text{Total number of seeds sown}} \times 100$$

3.4.4.4.2 Seedling shoot length (cm)

Ten normal healthy seedlings were selected randomly during the final count from each treatment for assessing the shoot length. Shoot length was evaluated as the distance from the collar region up to the shoot tip. The average seedling shoot length was worked out in centimetre.

3.4.4.4.3 Seedling root length (cm)

Seedling root length was measured as the distance from the collar region to the primary root tip from those plants which were used for recording the shoot length. The average seedling root length was enumerated in centimetre.

3.4.4.4.4 Seedling dry weight (g)

Seedling dry weight was measured by drying the seedlings which were used for measuring mean seedling length in a hot air oven for 24 hours at 85 ± 1°C. After drying, the seedlings are kept in a desiccator for 45 minutes for cooling. After cooling, the reading was recorded using the weighing balance. The average seedling dry weight was worked out in grams (Copeland and McDonald, 2001).

3.4.4.4.5 Mean germination time (MGT)

Ellis and Robert (1981) formulated the equation for mean germination time (MGT) as

$$\text{Mean germination time (MGT)} = \frac{\Sigma Dn}{\Sigma n}$$

Where, n = number of seedlings emerging on day ‘D’

D = day after planting / number of days counted from the beginning of germination

The seed lot having greater germination index is considered to be more vigorous.

3.4.4.4.6 Time taken for 50% germination (T_{50})

Coolbear *et al.* (1984) formulated the equation for time taken for 50% germination (T_{50}) which was modified by Farooq *et al.* (2006) as

$$T_{50} = ti + \left[\frac{\frac{(N)}{2} - ni}{nj - ni}\right] \times (tj - ti)$$

Where,

N = Final number of seeds germinated

ni and nj= Total number of seeds germinated by adjacent counts at times ti and tj while ni < N/2 < nj

3.4.4.4.7 Seedling vigour index (SVI)

Seedling vigour index was evaluated as vigour index I and vigour index II.

3.4.4.4.7.1 Vigour index- I

Vigour index- I was computed using the equation formulated by Abdul-Baki and Anderson (1973) and expressed in whole number.

Vigour index I = Germination (%) x Total seedling length (cm)

3.4.4.4.7.2 Vigour index II

Vigour index- II was determined using the equation proposed by Bewley and Black (1994).

Vigour index II = Germination (%) x Seedling dry weight (mg)

3.4.4.4.8 Electrical conductivity (EC) of seed leachate (μScm^{-1})

Four replications of thirty seeds randomly drawn from each treatment were used for recording electrical conductivity (EC) of seed leachate. The seeds were first surface sterilized with $HgCl_2$ (0.1%) for 5-10 minutes. It was then washed thoroughly with distilled water. Later the seeds were soaked in 25 ml distilled water in beakers and incubated at 25°C ± 1°C. The solution was stirred occasionally. The beakers were left covered to avoid contaminants and to reduce evaporation. After 24 hours, decant the leachate to another beaker for taking the reading. Electrical conductivity (EC) of seed leachate was estimated using digital conductivity meter with a cell constant of 0.1.

3.4.4.5 Seed moisture (%)

Two replicates of four gram seeds were used for determining the moisture content (ISTA, 1976 b). Modified ISTA high constant temperature oven method was followed. The aluminium cup and lid were weighed to accurately 4 decimal places. Distribute the weighed seeds evenly over the base of the dish and weigh it along with the cup and lid. After removing the lid, place the samples in the oven at 103 ± 2°C. The samples were heated for 17 ± 1 hour. After drying, the aluminium cup was closed using the lid and placed in the desiccator for 30 to 45 minutes. Then weigh each cup using an analytical balance. The moisture content was determined as per equation below and expressed as per cent (ISTA, 1999).

$$\text{Moisture content (\%)} = \frac{M2-M3}{M2-M1} \times 100$$

Where,

M_1 = Weight of the aluminium cup with lid alone

M_2 = Weight of the aluminium cup with lid + Sample before drying

M_3 = Weight of the aluminium cup with lid + Sample after drying

3.4.4.6 Seed infection (%)

Seed micro flora study was carried out using the blotter paper method.

3.4.4.6.1 Blotter method

Eight replications of 50 seeds were used for seed health testing (ISTA, 1999). The "blotter test" method was employed to determine the incidence of fungi in seeds. In this method, three layers of absorbent paper (90 mm) were placed in each petri dish and soaked with sterile distilled water. The excess water was drained off and with the help of forceps, 20-25 seeds were positioned aseptically at equi-distance on the surface of the filter paper. The petri plates were kept at 20 ± 2°C with alternating cycles of 12 hours of darkness and NUV light for seven days. After incubation, the seeds were individually evaluated under a stereo-binocular microscope and the results were expressed in percent of seeds with fungus. Slides were prepared and examined under a light microscope.

3.5 Statistical analysis

The data obtained from field experiments related to different characters and storage studies related to different seed quality parameters were subjected to statistical analysis by applying the technique of Fisher’s method of analysis of variance (ANOVA) for randomized block design (RBD) and completely randomized block design (CRD) with two factor combinations (Gomez and Gomez, 1984). The significance was tested by Duncan’s Multiple Range Test (DMRT) (Snedecor and Cohran, 1967). If the F values were found significant, then critical differences (CD) were calculated. Statistical analysis of data was performed using Web Agri Stat Package (WASP) developed by ICAR, OP stat and SPSS software. Before analysis, the percentage data was transformed into arc sine root transformation.

3.5.1 ANOVA for factorial design

To estimate the effect of both varieties and time of planting and varieties and various fertilizer levels on dependent variables, the data recorded from each experiment was analyzed using factorial ANOVA. The interactions between the independent variables or factors considered can be known using method and mean squares due to different variation were worked out (Gomez and Gomez, 1984).

Source of variation	Degree of freedom (df)	Sum of squares (SS)	Mean square (MS) = $\frac{SS}{df}$	Computed F
Replications	r – 1			
Treatments	t– 1	SS_T	MS_T	MS_T/MS_E
Factor A	a – 1	SS_A	MS_A	MS_A/MS_E
Factor B	b – 1	SS_B	MS_B	MS_B/MS_E
Factor(AB)	(a-1) (b-1)	SS_{AB}	MS_{AB}	MS_{AB}/MS_E
Error	ab (r-1)	SS_E	MS_E	
Total	n – 1	SS_{TO}	MS_{TO}	

Where,

t = Treatment

n = Total number of observation

SS_T = Treatment sum of squares

SS_E = Error sum of squares

SS_{TO} = Total sum of squares

MS_T = Mean square of treatments

MS_E = Mean square of error

SS_A = Sum of squares due to factor AMSA - mean sum of squares due to A

SS_B = Sum of squares due to factor BMSB - mean Sum of squares due to B

SS_{AB} = Sum of squares due to interaction ABMSAB - mean sum of squares due to AB

SS_E = Sum of squares due to error MSE - mean sum of squares due to error

4.1.3 Days to first flowering (Female)

The varieties, time of planting and their interaction were significant for this character (Table 6). Female flower emergence was early in Saubhagya (36.75 days) and late in Mudicode (40.86 days). With respect to different times of planting, December crop flowered early (36.32 days) followed by January (38.25 days) and February planting (41.85 days).

The days for female flower emergence varied from 43.45 days (V_2T_3) to 33.90 days (V_1T_1). V_2T_3 differed significantly from all other interactions.

4.1.4 Fruit length (cm)

The perusal of data indicated that the varieties and time of planting exerted significant influence on fruit length, but the interaction effect was non- significant (Table 7).

Mudicode recorded significantly longer fruits (23.91 cm) than Saubhagya (18.56 cm). Considering the interaction effect, fruit length varied from 17.84 (V_1T_2) to 26.01 cm (V_2T_1). V_2T_1 was on par with V_2T_2 (23.59 cm) and differed significantly with all other interactions.

4.1.5 Fruit girth (cm)

The results on fruit girth as influenced by varieties, time of planting and their interaction are presented in Table 7. It was observed that fruit girth was not significantly influenced by time of planting however, it was found to be significant with varieties and interaction between varieties and time of planting.

Mudicode recorded 26.46 cm of fruit girth than Saubhagya (23.70 cm). Fruit girth varied from 28.71 (V_2T_1) to 22.27 cm (V_1T_3). V_2T_1 was found to be on par with all other interactions except V_1T_3 (22.27 cm).

$$Standard\ Error\ of\ Mean\ (SEm) = \sqrt{\frac{MSE}{r}}$$

$$Critical\ Difference\ (CD)@5\ \% = SEm\sqrt{2} \times t_{(0.05,\ edf)}$$

Where, $t_{(0.05,\ edf)}$ is the student's t table value at error degrees of freedom and at five per cent level of significance.

3.5.2 Pair wise comparison using DMRT test

When the total number of treatments is large, Duncan's Multiple Range Test (DMRT) is very useful for evaluation of all possible pairs of treatments in an experiment.

Classification of difference between any two treatments or means as significant or non-significant and computation of numerical boundaries is done using DMRT. However the DMRT requires calculation of a series and each corresponding to a particular series of pair comparisons, unlike the LSD test, in which a single value is required at a prescribed level. The following procedure is followed for ranking the data (Gomez and Gomez 1976).

Step 1: The treatment means were ranked in decreasing (or increasing) order. It is customary to rank the treatment means according to the order of preference.

Step 2: Estimate the S_d value following the appropriate procedure

$$S_d = \sqrt{\frac{2S^2}{r}}$$

Step 3: Compute the (t -1) values of the shortest significant ranges as:

$$R_p = \frac{(rp)\ (sd)}{\sqrt{2}} \text{for } p = 2, 3, \ldots\ldots, t$$

Where,

t - Total number of treatments

S - Standard error of the mean difference computed in step 2 r values - Tabular values of the significant ranges

P - Distance in rank between the pairs of treatment means to be compared (*i.e.,* p = 2 for the two means with consecutive rankings and p = t for the highest and lowest means)

Step 4: The treatment means which do not differ significantly from each other were identified and grouped together.

Step 5: According to the ranking, use the alphabet notation to present the test the result.

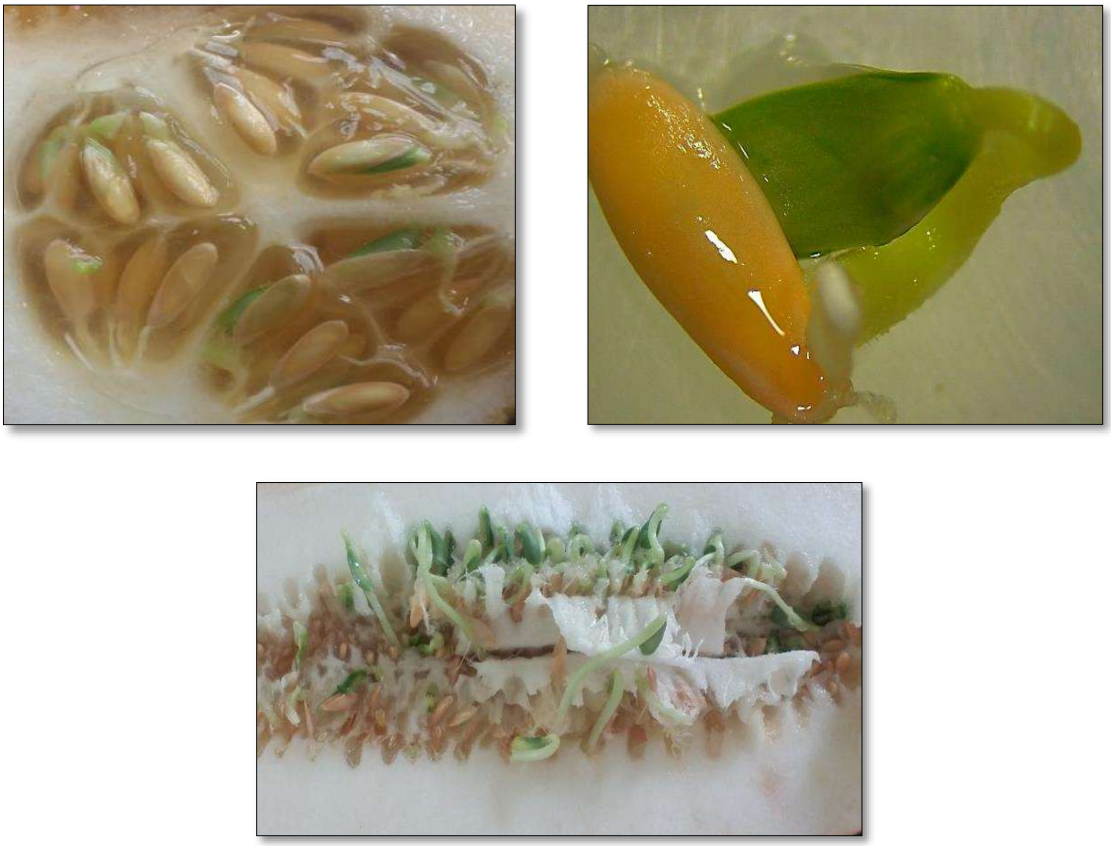


Plate 3: Viviparous sprouting in OP melon fruits

a. ***Penicillum* sp.**

b. ***Curvularia* sp.**

Plate 4: Seed microflora

Results

4. RESULTS

The present investigation entitled 'Potassium nutrition on vivipary and seed quality in oriental pickling melon (*Cucumis melo* var. *conomon* Mak.)' was conducted at the Department of Seed Science and Technology, College of Horticulture, Vellanikkara, Kerala Agricultural University (KAU), Thrissur during the year 2017 – 2019. The results obtained from the study are furnished below.

4.1 Experiment I: Effect of time of planting on vivipary in oriental pickling melon

The result pertaining to the effect of time of planting on flowering, fruit morphology and seed yield parameters is presented below.

4.1.1 Analysis of variance

Analysis of variance revealed significant differences among the treatments for characters like number of days for flowering, fruit characters, number of seeds per fruit, fresh weight and dry weight of seeds, 100 seed weight, vivipary, chaffy seed per cent and potassium content in fruit placenta and flesh among varieties, time of planting and their interaction (Table 5).

4.1.2 Days to first flowering (Male)

The days taken for the appearance of first male flower are furnished in Table 6. The result indicated that the varieties, time of planting and their interaction had significant influence on days to first male flower opening.

Days to flowering (Male flower) was early in Saubhagya (V_1- 26.55 days) when compared to Mudicode, (V_2 – 30.83 days). With regard to the time of planting, male flower opening was early in February planted crop (25.40 days) and late in December planted crop (32.25 days). The appearance of first male flower varied from to 22.35 days (V_1T_3) to 33.10 days (V_2T_1) when the interaction effect was considered. V_2T_1 varied significantly from all other interactions.

Table 5: Analysis of variance for fruit and seed yield attributes

Trait	Mean sum of Squares				
	Treatments	Factor A	Factor B	Factor A×B	Error
Days for male flower emergence (days)	63.95**	110.08**	94.27**	10.56**	1.02
Days for female flower emergence (days)	46.07**	101.68**	62.92**	1.41**	0.86
Fruit length (cm)	41.15**	171.52**	10.92 NS	6.20**	5.69
Fruit girth (cm)	18.31**	45.71**	15.05 NS	7.86 **	10.99
Fruit diameter (cm)	4.12**	11.13 **	1.86 NS	2.87**	2.28
Fruit weight (g)	625026.67**	2190708.38**	402312.04**	64900.45**	15414.85
Fruit yield per vine (kg)	0.51**	0.57**	0.57**	0.41**	0.01
K content in fruit placenta (%)	0.07**	0.04**	0.10**	0.06**	0.00
K content in flesh of fruits (%)	0.02**	0.01 **	0.04**	0.02**	0.00
Number of seeds per fruit	31349.66**	2.80 NS	23580.88 NS	54791.87 NS	19109.19
Fresh weight of seeds per fruit (g)	5.24**	11.26 NS	4.65 NS	2.82 NS	7.89
Dry weight of seeds per fruit (g)	1.78**	3.01 NS	2.24 NS	0.70 NS	3.63
Chaffy seeds (%)	693.96**	0.55 NS	1719.12**	15.50 **	89.43
Vivipary (%)	44.39**	0.18 NS	109.48**	1.42**	6.66
100 seed weight (g)	0.03**	0.002 NS	0.03 NS	0.03 NS	0.13
Seed yield (kg)	12.54**	0.001 NS	9.43 NS	21.92**	7.64

* The value was significant at 5% level of significance

** The value was significant at 1% level of significance

NS The value was non-significant

Table 6: Influence of varieties, time of planting and their interaction on flowering in oriental pickling melon

Treatments		Days for male flowering (Days)			Days for female flowering (Days)		
		Varieties		Mean	Varieties		Mean
		V_1 (Saubhagya)	V_2 (Mudicode)		V_1 (Saubhagya)	V_2 (Mudicode)	
Time of planting	T_1 - December	31.40	33.10	32.25	33.90	38.75	36.32
	T_2 - January	25.90	30.95	28.42	36.10	40.40	38.25
	T_3 - February	22.35	28.45	25.40	40.25	43.45	41.85
Mean		26.55	30.83		36.45	40.86	
C.D (0.05)		Varieties (V)	Time of planting (T)	V× T	Varieties (V)	Time of planting (T)	V× T
		0.88	1.07	1.52	0.81	0.99	1.40

Table 7: Influence of varieties, time of planting and their interaction on fruit morphological characters in oriental pickling melon

Treatments		Fruit length (cm)			Fruit girth (cm)			Fruit diameter(cm)		
		Varieties		Mean	Varieties		Mean	Varieties		Mean
		V_1 (Saubhagya)	V_2 (Mudicode)		V_1 (Saubhagya)	V_2 (Mudicode)		V_1 (Saubhagya)	V_2 (Mudicode)	
Time of planting	T_1 - December	19.14	26.01	22.58	23.92	28.71	26.31	12.45	14.87	13.66
	T_2 - January	17.84	23.59	20.72	24.91	25.74	25.33	13.20	13.26	13.23
	T_3 - February	18.71	22.13	20.42	22.27	24.93	23.60	11.89	13.50	12.70
Mean		18.56	23.91		23.70	26.46		12.51	13.88	
C.D (0.05)		Varieties (V)	Time of planting (T)	V× T	Varieties (V)	Time of planting (T)	V× T	Varieties (V)	Time of planting (T)	V× T
		2.07	NS	3.59	2.88	NS	5.00	1.32	NS	2.28

4.1.6 Fruit diameter (cm)

Results indicated that fruit diameter was influenced significantly by the varieties, and the interaction between varieties and time of planting (Table 7).

Significantly high fruit diameter was recorded by variety Mudicode (13.88 cm) than Saubhagya (12.51 cm). Considering the interaction, it varied from 14.87 cm (V_2T_1) to 11.89 cm (V_1T_3). V_2T_1 was on par with all the other interactions except V_1T_3 (11.89 cm).

4.1.7 Fruit weight (g)

The result on fruit weight is furnished in Table 8. The observations indicate that the varieties, time of planting and their interaction had significant influence on fruit weight.

Fruit weight was high in Mudicode variety (1073.30 g) than Saubhagya (469.05 g). With regard to planting time, fruit weight was significantly high in December palnting (1023.65 g), while in January (595.13 g) and February (694.75 g) it was on par with each other.

The fruit weight varied from 334.80 g in V_1T_2 to 1429.15 g in V_2T_1. V_2T_1 differed significantly from all other interactions. V_2T_3 (935.30 g) and V_2T_2 (855.45 g) were on par with each other and found next best to V_2T_1.

4.1.8 Fruit yield per vine (kg)

The perusal of result indicated that the varieties, time of planting and their interaction effect exerted significant influence on fruit length (Table 8).

Mudicode variety recorded significantly high fruit yield per vine (1.57 kg). Considering the effect of time of planting, the significantly high fruit yield per vine

Table 8: Influence of varieties, time of planting and their interaction on fruit weight and yield in oriental pickling melon

Treatments		Fruit weight (g)			Fruit yield per vine (kg)		
		Varieties		Mean	Varieties		Mean
		V_1 (Saubhagya)	V_2 (Mudicode)		V_1 (Saubhagya)	V_2 (Mudicode)	
Time of planting	T_1 - December	618.15	1429.15	1023.65	1.31	2.14	1.72
	T_2 - January	334.80	855.45	595.13	1.21	1.33	1.27
	T_3 - February	454.20	935.30	694.75	1.27	1.25	1.26
Mean		469.05	1073.30		1.26	1.57	
C.D (0.05)		Varieties (V)	Time of planting (T)	V× T	Varieties (V)	Time of planting (T)	V× T
		108.01	132.29	187.09	0.08	0.09	0.13

was observed in December planting (1.72 kg), while it was on par with each other in January (1.27 kg) and February (1.26 kg).

Interaction effects revealed that fruit yield per vine was the highest in V_2T_1 (2.14 kg) and differed significantly from other treatments. All the remaining treatments were on par with each other.

4.1.9 K content in fruit placenta (%)

Results of potassium content in the fruit placenta are furnished in Table 9. Significant differences were observed in K content in fruit placenta (%) as influenced by varieties, time of planting and their interaction. Significantly high potassium content was recorded in variety Mudicode (0.36%) than Saubhagya (0.28%). February sown crop recorded higher potassium per cent (0.44), while the December crop recorded the least value (0.22%).

Interaction effects revealed that potassium content in fruit placenta was the highest in V_2T_3 (0.58%) and differed significantly from other treatments. V_2T_2 (0.32%) and V_1T_3 (0.30%) were on par with each other and found next best to V_2T_3.

4.1.10 K content in flesh of fruits (%)

The perusal of results on potassium content in the fruit placenta are furnished in Table 9. Significant variations were observed with respect to varieties, time of planting and their interaction.

Mudicode variety (0.28%) recorded significantly high potassium per cent than Saubhagya (0.27%). High potassium content was observed for the crop planted in February planting (0.34%) and differed significantly from that observed in January (0.30%) and least value was recorded in December (0.21%). February planting differed significantly from others.

Table 9: Influence of varieties, time of planting and their interaction on potassium content of fruit

Treatments		K content in fruit placenta (%)			K content in flesh of fruits (%)		
		Varieties		Mean	Varieties		Mean
		V_1 (Saubhagya)	V_2 (Mudicode)		V_1 (Saubhagya)	V_2 (Mudicode)	
Time of planting	T_1 - December	0.25	0.19	0.22	0.25	0.17	0.21
	T_2 - January	0.27	0.32	0.30	0.27	0.27	0.27
	T_3 - February	0.30	0.58	0.44	0.29	0.40	0.34
Mean		0.28	0.36		0.27	0.28	
C.D (0.05)		Varieties (V)	Time of planting (T)	V× T	Varieties (V)	Time of planting (T)	V× T
		0.02	0.03	0.04	0.01	0.01	0.02

The potassium content varied from 0.17 per cent in V_2T_1 to 0.40 per cent in V_2T_3. V_2T_3 differed significantly from all other interactions.

4.1.11 Seeds per fruit

The average values on seeds per fruit are furnished in Table 10. The results revealed that the character was not influenced by the varieties, time of planting and their interaction.

4.1.12 Weight of seeds per fruit (g)

The mean values on the fresh and dry weight of the seeds per fruit as influenced by varieties, time of planting and their interaction is furnished in Table 10. The character was not influenced by the varieties, time of planting and their interaction.

4.1.13 Chaffy seeds (%)

The result on chaffy seed per cent as influenced by varieties, time of planting and their interaction is given in Table 11.

Chaffy seed per cent varied with time of planting. Crop raised in February registered the least per cent chaffy seeds (1.52%). It was significantly different from that observed in the other time of planting. The per cent chaffy seeds in fruits obtained from crops raised in December and January, was 29.44 and 23.22 respectively.

The per cent chaffy seed varied from 0.14 % (V_1T_3) to 29.92 % (V_1T_1). V_1T_1 was found to be on par with V_2T_1 (28.95%), V_1T_2 (24.57%) and V_2T_2 (21.87%). The least chaffy seed per cent was recorded in V_1T_3 (0.14%) and V_2T_3 (2.89 %).

Table 10: Influence of varieties, time of planting and their interaction on number of seeds per fruit and seed weight in oriental pickling melon

Treatments		Seeds per fruit			Fresh weight of seeds per fruit (g)			Dry weight of seeds per fruit (g)		
		Varieties			Varieties			Varieties		
		V_1 (Saubhagya)	V_2 (Mudicode)	Mean	V_1 (Saubhagya)	V_2 (Mudicode)	Mean	V_1 (Saubhagya)	V_2 (Mudicode)	Mean
Time of planting	T_1 - December	337.95	458.05	398.00	5.72	7.95	6.83	4.79	6.04	5.41
	T_2 - January	326.20	393.40	359.80	4.41	6.27	5.34	4.17	4.97	4.57
	T_3 - February	561.60	372.25	467.92	5.83	5.85	5.84	5.51	5.58	5.54
Mean		409.58	407.90		5.32	6.69		4.82	5.53	
C.D (0.05)		Varieties (V)	Time of planting (T)	V× T	Varieties (V)	Time of planting (T)	V× T	Varieties (V)	Time of planting (T)	V× T
		NS	NS	NS	NS	NS	NS	NS	NS	NS

4.1.14 Vivipary (%)

The results of vivipary furnished in Table 11 revealed that, there was a significant variation in occurrence of vivipary per cent with respect to time of planting.

The presence of viviparous seeds was the least in the crop raised in January (1.51%) and differed significantly from February planting (4.09%) and December raised crop (8.8%).The vivipary per cent varied from 9.12 per cent (V_2T_1) to 0.99 per cent (V_2T_3). V_2T_1 was on with V_1T_1 and differed significantly with the remaining treatments.

4.1.15 100 seed weight (g)

The results revealed that 100 seed weight was not significantly influenced by varieties, time of planting and their interaction (Table 12).

4.1.15 Seed yield (kg/ha)

The results regarding seed yield are depicted in Table 12. The result revealed significant differences in seed yield due to the interaction between varieties and time of planting. V_1T_3 (11.23 kg ha^{-1}) recorded higher seed yield and was found to be on par with V_2T_1 (9.16 kg ha^{-1}), V_2T_2 (7.8 kg ha^{-1}) and V_2T_3 (7.45 kg ha^{-1}).

4.2 Effect of potassium levels on vivipary in oriental pickling melon

The results of the effect of fertilizer levels on flowering, fruit morphology and seed yield parameters are furnished below.

Table 11: Influence of varieties, time of planting and their interaction on chaffy seed and vivipary per cent in oriental pickling melon

Treatments		Chaffy seeds (%)			Vivipary (%)		
		Varieties			Varieties		
		V_1 (Saubhagya)	V_2 (Mudicode)	Mean	V_1 (Saubhagya)	V_2 (Mudicode)	Mean
Time of planting	T_1 - December	29.92	28.95	29.44	8.49	9.12	8.80
	T_2 - January	24.57	21.87	23.22	4.14	4.04	4.09
	T_3 - February	0.14	2.89	1.52	2.03	0.99	1.51
Mean		18.21	17.91		4.89	4.72	
C.D (0.05)		Varieties (V)	Time of planting (T)	V× T	Varieties (V)	Time of planting (T)	V× T
		NS	10.08	14.25	NS	2.75	3.89

Table 12: Influence of varieties, time of planting and their interaction on 100 seed weight and seed yield in oriental pickling melon

Treatments		100 seed weight (g)			Seed yield (kg/ha)		
		Varieties		Mean	Varieties		Mean
		V_1 (Saubhagya)	V_2 (Mudicode)		V_1 (Saubhagya)	V_2 (Mudicode)	
Time of planting	T_1 - December	1.58	1.56	1.57	6.76	9.16	7.96
	T_2 - January	1.49	1.42	1.45	6.52	7.87	7.20
	T_3 - February	1.39	1.54	1.46	11.23	7.45	9.34
Mean		1.49	1.51		8.17	8.16	
C.D (0.05)		Varieties (V)	Time of planting (T)	V× T	Varieties (V)	Time of planting (T)	V× T
		NS	NS	NS	NS	NS	4.17

4.2.1 Analysis of variance

Analysis of variance revealed significant differences among the treatments for characters like number of days for flowering, fruit characters, number of seeds per fruit, fresh weight and dry weight of seeds, 100 seed weight, vivipary, chaffy seed per cent and potassium content in fruit placenta and flesh among varieties, time of planting and their interaction (Table 13).

4.2.2 Days to first flowering (Male)

Significant differences was observed with respect to varieties and their interaction (varieties and potassium levels) on days to first male flowering (Table 14).

Variety Mudicode took longer days (29.81 days) compared to Saubhagya (26.98 days). Considering the interaction, days to first flowering (Male) was on par with each other in all treatments.

4.2.3 Days to first flowering (Female)

The results on days taken for the appearance of first female flower as influenced by varieties, different potassium nutrient levels and their interaction are presented in Table 14. The trait was significantly influence by the variety, and the interaction between varieties and potassium levels.

Variety Mudicode took longer days (38.48 days) compared to Saubhagya (33.73 days). Days for female flower emergence varied from 30.10 days (V_1T_3) to V_2T_5 (40.80 days) and V_2T_3 (40.50 days).

The female flower opening was early under the treatment combination, V_1T_3 (30.10 days). However, V_2T_5 and V_2T_3 took the longest for emergence of female flower (40.80 and 40.50 days respectively).

Table 13: Analysis of variance for fruit and seed yield attributes

Trait	Mean sum of squares				
	Treatments	**Factor A**	**Factor B**	**Factor A×B**	**Error**
Days for male flower emergence (Days)	8.97**	48.17 **	5.92^{NS}	4.18**	6.77
Days for female flower emergence (Days)	19.76**	135.38**	6.65 ^{NS}	9.75**	13.33
Fruit length (cm)	8.21**	70.38**	2.39**	1.60**	0.19
Fruit girth (cm)	36.56**	302.46**	10.10**	9.83**	1.83
Fruit diameter (cm)	12.77**	80.81**	8.18 **	3.75**	0.71
Fruit weight (g)	35433.61**	42892.22 ^{NS}	52962.43**	16413.06**	11029.04
Fruit yield per vine (kg)	0.08**	0.17**	0.10**	0.04**	0.001
K content in fruit placenta (%)	0.10**	0.41**	0.11**	0.03**	0.00
K content in flesh of fruits (%)	0.03**	0.04**	0.04**	0.01**	0.00
Number of seeds per fruit	1564.77**	13020.04 **	500.01 ^{NS}	338.48**	1713.82
Fresh weight of seeds per fruit (g)	3.37**	19.84**	1.92**	1.54**	0.96
Dry weight of seeds per fruit (g)	3.44**	21.81**	1.66**	1.55**	0.98
Chaffy seeds (%)	13.57**	0.09 ^{NS}	28.57**	1.27**	0.79
Vivipary (%)	18.21**	50.47**	26.22**	3.74**	0.16
100 seed weight (g)	0.02**	0.05 ^{NS}	0.01 ^{NS}	0.02**	0.02
Seed yield	0.63**	5.21**	0.20 ^{NS}	0.14**	0.69

* The value was significant at 5% level of significance

** The value was significant at 1% level of significance

^{NS} The value was non-significant

Table 14: Influence of varieties, nutrient levels and their interaction on flowering in oriental pickling melon

Treatments		Days for male flower emergence (Days)			Days for female flower emergence (Days)		
		Varieties		Mean	Varieties		Mean
		V_1 (Saubhagya)	V_2 (Mudicode)		V_1 (Saubhagya)	V_2 (Mudicode)	
Potassium levels	T_1 – POP (70:25:25)	26.70	28.70	28.00	34.40	37.60	36.00
	T_2 – No K	26.80	32.10	29.45	35.80	39.50	37.65
	T_3 – POP + 25%K	26.60	28.10	27.35	30.10	40.50	35.30
	T_4 – POP + 50%K	27.10	27.00	27.05	33.30	36.80	35.05
	T_5 – POP + 0.5% FS	26.90	30.70	28.80	34.70	40.80	37.75
	T_6 – Organic POP	27.80	32.30	30.05	34.10	35.70	34.90
Mean		26.98	29.81		33.73	38.48	
C.D (0.05)		Varieties (V)	Potassium levels (T)	V× T	Varieties (V)	Potassium levels (T)	V× T
		2.34	NS	5.73	3.28	5.68	8.03

4.2.4 Fruit length (cm)

The result on fruit length as influenced by varieties, levels of potassium and their interaction is furnished in Table 15. Significant differences were observed for varieties, potassium levels and their interaction on fruit length.

Mudicode recorded high fruit length of 23.90 cm than Saubhagya (20.47 cm). Considering different levels of potassium, the fruit length varied from 23.66 cm (T_5 - POP + 0.5% FS) to 21.65 cm (T_1; POP). T_5 (POP + 0.5% FS) differed significantly among the treatments.

The interaction effect resulted in variation of fruit length from 26.40 cm (V_2T_5) to 20.10 cm (V_1T_6). V_2T_5 differed significantly with all other treatments.

V_2T_3 (24.10 cm), V_2T_4 (24.00 cm) and V_2T_2 (23.57 cm) were on par with each other and found next best to V_2T_5.

4.2.5 Fruit girth (cm)

The results revealed that varieties, potassium levels and their interaction had a significant influence on fruit girth (Table 15). Fruit girth of 28.62 cm and 21.52 cm was recorded in Mudicode and Saubhagya varieties, respectively. With regard to various potassium levels, fruit girth was significantly high in T_5 - POP + 0.5% FS (23.66 cm). T_5 was on par with T_3- POP + 25% K (26.20 cm), T_4 - POP + 50% K (25.80 cm) and T_1 - POP (25.45 cm) and differed significantly from others.

The fruit girth varied from V_1T_2 (20.90 cm) to V_2T_3 (31.20 cm). V_2T_3 was found to be on par with V_2T_4 (30.10 cm) and V_2T_5 (30.90 cm) and differed significantly from all other interactions.

Table 15: Influence of varieties, nutrient levels and their interaction on fruit morphological characters

	Treatments	Fruit length (cm)			Fruit girth (cm)			Fruit diameter(cm)		
		Varieties		Mean	Varieties		Mean	Varieties		Mean
		V_1 (Saubhagya)	V_2 (Mudicode)		V_1 (Saubhagya)	V_2 (Mudicode)		V_1 (Saubhagya)	V_2 (Mudicode)	
Potassium levels	T_1 – POP	20.46	22.84	21.65	21.10	29.80	25.45	13.62	17.60	15.61
	T_2 – No K	20.24	23.57	21.91	20.90	26.30	23.60	13.80	16.40	15.10
	T_3 – POP + 25%K	20.58	24.10	22.34	21.20	31.20	26.20	14.40	19.80	17.10
	T_4 – POP + 50%K	20.54	24.00	22.27	21.50	30.10	25.80	14.10	18.60	16.35
	T_5 – POP + 0.5% FS	20.92	26.40	23.66	22.50	30.90	26.70	14.66	19.90	17.28
	T_6 – Organic POP	20.10	22.48	21.29	21.90	23.40	22.65	13.30	13.60	13.45
Mean		20.47	23.90		21.52	28.62		13.98	17.65	
C.D (0.05)		Varieties (V)	Potassium levels (T)	V× T	Varieties (V)	Potassium levels (T)	V× T	Varieties (V)	Potassium levels (T)	V× T
		0.40	0.69	0.97	1.22	2.11	2.98	0.76	1.31	1.86

4.2.6 Fruit diameter (cm)

The mean value on fruit diameter furnished in Table 15 revealed that varieties, potassium levels and the interaction had significant influence on fruit diameter.

Fruit diameter was high in variety Mudicode (17.65 cm) compared to Saubhagya (13.98 cm). Considering the potassium levels, the fruit diameter was significantly higher in T_5 – POP + 0.5% K (17.28 cm) which was on par with T_3-POP +25% K and T_4 – POP +50% K (16.35 cm).

Fruit diameter varied from 19.90 cm (V_2T_5) to 13.30 cm (V_1T_6) among the interaction. V_2T_5 was found to be on par with V_2T_3 (19.80 cm), and V_2T_4 (18.60 cm) and differed significantly from all other treatment interactions.

4.2.7 Fruit weight (g)

The result on the effect of varieties, different levels of potassium and their interaction on fruit weight is depicted in Table 16. The result indicated that the potassium levels and the interaction between varieties and levels of potassium had significant influence on fruit weight.

Significantly higher fruit weight was recorded in treatments, T_3 - POP + 25% K (678.95 g), T_5 - POP + 0.5% FS (677.20 g) and T_4 - POP + 50% K (633.35 g). The least value for fruit weight was recorded in T6 - organic POP (441.85 g) which was found to on par with T_2 - POP with no K (457.05 g) and T_1 - POP (468.45 g).

Among the interaction, fruit weight varied from 340.90 g (V_1T_6) to 742.20 g (V_1T_3). V_1T_3 was on par with V2T5 (714.10 g), V_2T_4 (640.40 g), V_1T_5 (640.30 g), V_1T_4 (626.30 g), V_2T_3 (615.70 g), V_2T_1 (575.00 g), and V_2T_2 (522.50 g) and differed significantly from others. The least fruit weight were observed in V_1T_6

(340.90 g) which was statistically on par with V_1T_1 (361.90 g) and V_1T_2 (391.60 g).

4.2.8 Fruit yield per vine (kg)

Table 16 revealed the presence of significant differences among varieties, different potassium levels, and their interaction on fruit yield per vine.

Significantly high fruit yield per vine was observed for the variety, Mudicode (1.28 kg) than Saubhagya (1.11 kg). Considering different potassium levels, 1.41 kg of fruit yield per vine was recorded with treatment, POP + 0.5% FS (T_5) and differed significantly from other treatments. The least value was recorded with T_6 - organic POP (0.98 kg).

Considering the interaction effect, fruit yield per vine ranged between 1.63 kg (V_2T_5) and 0.93 Kg (V_2T_6).Fruit yield per vine varied from 1.63 kg (V_2T_5) to 0.93 kg (V_2T_6). V_2T_5 differed significantly from all other interactions.

4.2.9 K content in fruit placenta (%)

The results obtained for K content in fruit placenta as influenced by varieties, different levels of potassium, and their interaction are furnished in Table 17. Significant differences were observed with respect to varieties, potassium levels and their interaction.

High potassium per cent in fruit placenta was observed for variety Mudicode (0.63%) compared to Saubhagya (0.37%). Significantly high potassium per cent was recorded in T_5 - POP + 0.5% FS (0.73%) whereas, the least was in treatment without K application i.e., T_2 (0.27%).

Considering the interaction, potassium content in fruit placenta ranged from 0.96 per cent (V_2T_5) to 0.22 per cent (V_1T_6). V_2T_5 show significant differences as

Table 16: Influence of varieties, nutrient levels and their interaction on fruit weight and yield in oriental pickling melon

Treatments		Fruit weight (g)			Fruit yield per vine (kg)		
		Varieties		Mean	Varieties		Mean
		V_1 (Saubhagya)	V_2 (Mudicode)		V_1 (Saubhagya)	V_2 (Mudicode)	
Potassium levels	T_1 – POP (70:25:25)	361.90	575.00	468.45	1.04	1.20	1.12
	T_2 – No K	391.60	522.50	457.05	1.06	1.16	1.11
	T_3 – POP + 25%K	742.20	615.70	678.95	1.23	1.27	1.25
	T_4 – POP + 50%K	626.30	640.40	633.35	1.13	1.49	1.31
	T_5 – POP + 0.5% FS	640.30	714.10	677.20	1.18	1.63	1.41
	T_6 – Organic POP	340.90	542.80	441.85	1.02	0.93	0.98
Mean		517.20	601.75		1.11	1.28	
C.D (0.05)		Varieties (V)	Potassium levels (T)	V× T	Varieties (V)	Potassium levels (T)	V× T
		NS	163.45	231.15	0.04	0.06	0.09

compared to all other interactions. V_2T_4 (0.745), V_2T_3 (0.67%) and V_2T_1 (0.63%) were on par with each other and found best next to V_2T_5.

4.2.10 K content in flesh of fruits (%)

The results furnished in Table 17 explicated that varieties, potassium levels, and their interaction had significant influence on potassium content in the fruit flesh.

Among the varieties, potassium per cent in the flesh of fruits was high in Mudicode variety (0.42%) compared to Saubhagya (0.34%). Significantly high per cent of potassium in fruit flesh was recorded in T_4 - POP + 50% K (0.53%) however, the lowest per cent was in the fruits collected from treatment, T_2 - POP with no K (0.26%) which was found to be on par with T_6 - organic POP (0.28%).

Among the interaction, per cent of potassium in fruit flesh varied from 0.57% (V_2T_4) to 0.22% (V_2T_2). V_2T_4 was on par with V_2T_3 (0.51%) and V_1T_4 (0.50%) and differed significantly with all other combinations.

4.2.11 Seeds per fruit

The result on number of seeds per fruit is furnished in Table 18. The data revealed that varieties and the interaction between varieties and potassium levels were significant with respect to number of seeds per fruit.

Number of seeds per fruit was high in variety Saubhagya (385 seeds) than Mudicode (338 seeds). The number of seeds per fruit varied from 407 seeds (V_1T_5) to 312 seeds (V_2T_6). V_1T_5 was on par with all the other treatments.

4.2.12 Fresh weight of seeds per fruit (g)

The mean values for fresh weight of seeds per fruit is furnished in Table 18. The data indicated that the effect of varieties, different potassium levels, and their interaction was significant.

Table 17: Influence of varieties, nutrient levels and their interaction on potassium content of fruits in oriental pickling melon

	Treatments	K content in fruit placenta (%)			K content in flesh of fruits (%)		
		Varieties		Mean	Varieties		Mean
		V_1 (Saubhagya)	V_2 (Mudicode)		V_1 (Saubhagya)	V_2 (Mudicode)	
Potassium levels	T_1 – POP (70:25:25)	0.32	0.63	0.47	0.29	0.43	0.36
	T_2 – No K	0.30	0.25	0.27	0.29	0.22	0.26
	T_3 – POP + 25%K	0.40	0.67	0.54	0.37	0.51	0.44
	T_4 – POP + 50%K	0.45	0.74	0.59	0.50	0.57	0.53
	T_5 – POP + 0.5% FS	0.51	0.96	0.73	0.35	0.45	0.40
	T_6 – Organic POP	0.22	0.51	0.36	0.24	0.32	0.28
Mean		0.37	0.63		0.34	0.42	
C.D (0.05)		Varieties (V)	Potassium levels (T)	V× T	Varieties (V)	Potassium levels (T)	V× T
		0.05	0.08	0.11	0.04	0.07	0.10

Among the varieties, Mudicode variety (8.07 g) recorded high fresh weight of seeds compared to Saubhagya (6.25 g). Considering the different potassium levels, significantly higher fresh weight was recorded in T_4 - POP + 50% K (8.03 g) which were found to be on par with T_5 - POP + 0.5% FS (7.69 g), T_2 - POP with no K (7.12 g), T_3 - POP + 25% K (7.11 g) and T_1 - POP (6.99 g). The least value for fresh weight was noted in T_6 - organic POP (6.01 g).

The fresh weight of seeds ranged from 9.62 g (V_2T_5) to 5.10 g (V_1T_6). V_2T_5 was found to be on par with V_2T_4 (8.58 g), V_2T_1 (8.10 g), V_2T_3 (8.00 g), and V_1T_4 (7.48 g).

4.2.13 Dry weight of seeds per fruit (g)

The effect of varieties and potassium levels on the dry weight of seeds per fruit was found to be significant from the result depicted in Table 18. Their interaction was also found to be significant.

The high value of dry weight of seeds was per fruit recorded in variety Mudicode (7.89 g) than Saubhagya (5.98 g). Significantly higher dry weight of seeds was noted in T_4 - POP + 50% K (7.77 g) which was found to be on par with all the other treatments.

Considering the interaction, dry weight value ranges from 9.40 g (V_2T_5) to 4.97 g (V_1T_6). V_2T_5 (9.40 g) which was on par with V_2T_4 (8.39 g), V_2T_1 (7.91 g), and V_2T_3 (7.85 g). The least value for dry weight was noticed in V_1T_6 (4.97 g).

4.2.14 Chaffy seeds (%)

Data furnished in Table 19 show a significant difference among different potassium levels and the interaction between varieties and potassium levels while no significant influence was observed on chaffy seeds by the effect of varieties.

Table 18: Influence of varieties, time of planting date and their interaction on number of seeds per fruit and seed weight in oriental pickling melon

Treatments		Seeds per fruit			Fresh weight of seeds per fruit (g)			Dry weight of seeds per fruit (g)		
		Varieties		Mean	Varieties		Mean	Varieties		Mean
		V_1 (Saubhagya)	V_2 (Mudicode)		V_1 (Saubhagya)	V_2 (Mudicode)		V_1 (Saubhagya)	V_2 (Mudicode)	
Potassium levels	T_1 – POP	371.60	334.70	353.15	5.88	8.10	6.99	5.57	7.91	6.74
	T_2 – No K	375.60	350.80	363.20	7.05	7.18	7.12	6.78	7.01	6.90
	T_3 – POP + 25%K	395.70	337.90	367.80	6.22	8.00	7.11	6.02	7.85	6.94
	T_4 – POP + 50%K	384.20	354.50	369.35	7.48	8.58	8.03	7.14	8.39	7.77
	T_5 – POP + 0.5% FS	406.70	338.10	372.40	5.76	9.62	7.69	5.42	9.40	7.41
	T_6 – Organic POP	373.80	312.10	342.95	5.10	6.92	6.01	4.97	6.78	5.88
Mean		384.60	338.02		6.25	8.07		5.98	7.89	
C.D (0.05)		Varieties (V)	Potassium levels (T)	V× T	Varieties (V)	Potassium levels (T)	V× T	Varieties (V)	Potassium levels (T)	V× T
		37.20	NS	91.12	0.88	1.53	2.16	0.89	1.54	2.17

The least per cent of chaffy seeds was registered in treatment, T_5 - POP + 0.5% FS (1.54%) which was on par with, T_4 - POP + 50% K (2.23%). T_5 differed significantly with all other treatments. T_2 (POP with no K) recorded the highest per cent of chaffy seeds (8.33%) among the potassium levels.

The interaction values varied from 8.44 per cent (V_2T_2) to 1.35 per cent (V_2T_5). V_2T_5 was found to be on par with V_1T_5 (1.73%), V_2T_4 (2.05%), V_1T_4 (2.41%) and V_2T_3 (2.69%).

4.2.15 Vivipary (%)

The result on vivipary per cent as influenced by varieties, potassium levels, and their interaction is furnished in Table 19. The data revealed that the effect of varieties, potassium levels and their interaction was significant.

Least number of viviparous seeds was recorded in Saubhagya (2.46%) with respect to varieties. The occurrence of viviparous seeds was the least in treatment, T_5 - POP + 0.5% FS (1.42%) which was on par with T_4 - POP + 50% K (1.72%) and differed significantly from all other treatments.

4.2.16 100 seed weight (g)

The results revealed that the interaction between varieties and nutrient levels was significant for 100 seed weight. The seed weight varied from 1.83 g (V_2T_2) to 1.52 g (V_1T_1). The least seed weight was recorded in V_1T_1 (1.52%) (Table 20).

4.2.17 Seed yield (kg/ha)

The results on seed yield as influenced by varieties, nutrient levels, and their interaction are furnished in Table 20. The data explicated that varieties and the interaction between varieties and potassium levels showed a significant effect on this trait while the effect of potassium levels was found to be non-significant.

Table 19: Influence of varieties, nutrient levels and their interaction on chaffy seeds and vivipary per cent

Treatments		Chaffy seeds (%)			Vivipary (%)		
		Varieties		Mean	Varieties		Mean
		V_1 (Saubhagya)	V_2 (Mudicode)		V_1 (Saubhagya)	V_2 (Mudicode)	
Potassium levels	T_1 – POP (70:25:25)	4.54	6.62	5.58	1.76	7.23	4.50
	T_2 – No K	8.21	8.44	8.33	6.41	9.42	7.91
	T_3 – POP + 25%K	3.95	2.69	3.32	1.23	3.41	2.32
	T_4 – POP + 50%K	2.41	2.05	2.23	1.14	2.29	1.72
	T_5 – POP + 0.5% FS	1.73	1.35	1.54	1.05	1.79	1.42
	T_6 – Organic POP	6.45	6.86	6.66	3.17	8.02	5.60
Mean		4.55	4.67		2.46	5.36	
C.D (0.05)		Varieties (V)	Potassium levels (T)	V× T	Varieties (V)	Potassium levels (T)	V× T
		NS	1.38	1.95	0.35	0.61	0.87

Table 20: Influence of varieties, nutrient levels and their interaction on 100 seed weight and seed yield

Treatments		100 seed weight (g)			Seed yield		
		Varieties		Mean	Varieties		Mean
		V_1 (Saubhagya)	V_2 (Mudicode)		V_1 (Saubhagya)	V_2 (Mudicode)	
Potassium levels	T_1 – POP (70:25:25)	1.52	1.72	1.62	7.43	6.69	7.06
	T_2 – No K	1.57	1.83	1.70	7.51	7.02	7.26
	T_3 – POP + 25%K	1.55	1.74	1.65	7.91	6.76	7.34
	T_4 – POP + 50%K	1.59	1.68	1.64	7.68	7.09	7.39
	T_5 – POP + 0.5% FS	1.75	1.65	1.70	8.13	6.76	7.45
	T_6 – Organic POP	1.68	1.61	1.65	7.48	6.24	6.86
Mean		1.61	1.71		7.69	6.76	
C.D (0.05)		Varieties (V)	Potassium levels (T)	V× T	Varieties (V)	Potassium levels (T)	V× T
		NS	0.21	0.30	NS	1.29	1.82

Saubhagya variety recorded high seed yield (7.69 $kgha^{-1}$) than Mudicode (6.76 $kgha^{-1}$). The seed yield varied from 8.13 $kgha^{-1}$ (V_1T_5) to 6.24 $kgha^{-1}$ (V_2T_6) due to the interaction effect. Least seed yield was recorded in V_2T_6 (6.24 $kgha^{-1}$) whereas, V_1T_5 (8.13 $kgha^{-1}$) recorded higher seed yield which was on par with all the other treatments.

4.3 Seed storage studies

4.3.1 Analysis of variance

Analysis of variance revealed wide variations in the degree of influence by varieties, the potassium nutrition levels and their interaction on the seed quality parameters studied, before and during the storage period.

4.3.2 Initial Seed quality

The data on initial seed quality parameters of seeds collected from experiment-II was determined at the start of the storage period is given in Table 21 and their interaction is furnished in Table 22.

Before storage, no significant differences were observed in the seed quality parameters between the varieties Mudicode and Saubhagya except root length and mean germination time.

Level of potassium nutrition was found to influence significantly the germination per cent (T_5 -100% to T_2 - 95%), shoot length (T_2 - 20.50 cm to T_1 - 19.28 cm), root length (T_4 - 8.01cm to T_6 - 9.27 cm), vigour index I (T_5 - 3013 to T_1 - 2856) and electrical conductivity (T_4 - 15.12 μScm^{-1} to T_1 - 21.18 μScm^{-1}).

Interaction between the varieties and the levels of potassium nutrition was found to exert a significant influence on shoot length (V_1T_1 - 19.25 cm to V_1T_2 - 20.77 cm), root length (V_2T_4 - 6.03 cm to V_1T_6 - 10.80 cm), vigour index I (V_1T_1 and V_2T_1 - 2856 to V_1T_5 and V_2T_5 - 3013), electrical conductivity (V_1T_2 - 14.50

Table 21: Influence of varieties and nutrient levels on seed quality parameters before storage

Details	Germination (%)	Shoot length (cm)	Root length (cm)	Dry weight (g)	VI-I	VI-II	EC (μScm^{-1})	MGT (days)	T_{50} (days)	Seed moisture (%)
Varieties										
V_1 – Saubhagya	97.67 (79.53)	20.04	10.34	0.027	2972	2626	17.88	2.68	2.10	6.04
V_2 – Mudicode	96.83 (77.72)	20.01	6.64	0.025	2972	2423	17.47	2.57	2.02	6.04
CD (0.05)	**NS**	**NS**	**0.10**	**NS**	**NS**	**NS**	**NS**	**0.05**	**NS**	**NS**
Potassium levels										
T_1 – POP	96.00 (74.05)	19.28	8.28	0.025	2856	2373	21.18	2.65	2.08	6.03
T_2 – No K	95.00 (71.93)	20.50	8.49	0.026	2979	2446	15.28	2.61	2.08	6.02
T_3 – POP + 25%K	99.00 (84.30)	20.34	8.13	0.027	3011	2697	19.81	2.67	2.11	6.05
T_4 – POP + 50%K	97.50 (77.37)	20.13	8.01	0.025	2992	2476	15.12	2.59	2.07	6.04
T_5 – POP + 0.5% FS	100.00 (90.05)	20.04	8.76	0.029	3013	2889	16.51	2.62	2.08	6.05
T_6 – Organic POP	96.00 (74.05)	19.88	9.27	0.024	2979	2265	18.19	2.63	1.95	6.06
CD (0.05)	**6.25**	**0.27**	**0.18**	**NS**	**34**	**NS**	**1.37**	**NS**	**NS**	**NS**

Table 22:-Interaction effect of potassium levels and varieties on seed quality parameters before storage

Treatments	Germination (%)	Shoot length (cm)	Root length (cm)	Dry weight (g)	VI-I	VI-II	EC (µScm-1)	MGT (Days)	T_{50} (Days)	Seed moisture (%)
Interaction (V× T)										
V_1T_1	97.00 (76.17)	19.25	10.05	0.027	2856	2640	20.50	2.53	1.93	6.02
V_1T_2	95.00 (71.93)	20.77	10.42	0.026	2979	2500	14.50	2.54	2.04	6.03
V_1T_3	99.00(84.30)	20.11	10.16	0.027	3011	2721	20.75	2.79	2.23	6.05
V_1T_4	98.00(78.56)	20.09	9.99	0.026	2992	2622	15.10	2.68	2.19	6.03
V_1T_5	100.00(90.05)	19.98	10.61	0.027	3013	2688	18.20	2.75	2.19	6.02
V_1T_6	97.00(76.17)	20.08	10.80	0.027	2979	2582	18.25	2.82	2.05	6.08
V_2T_1	95.00(71.93)	19.32	6.52	0.022	2856	2106	21.85	2.77	2.23	6.03
V_2T_2	95.00(71.93)	20.22	6.56	0.025	2979	2392	16.05	2.67	2.13	6.00
V_2T_3	99.00(84.30)	20.58	6.10	0.027	3011	2673	18.86	2.55	1.99	6.05
V_2T_4	97.00(76.17)	20.17	6.03	0.024	2992	2329	15.15	2.51	1.94	6.05
V_2T_5	100.00(90.05)	20.10	6.90	0.031	3013	3090	14.82	2.49	1.98	6.08
V_2T_6	95.00(71.93)	19.69	7.74	0.020	2979	1948	18.12	2.44	1.85	6.04
CD (0.05)	**NS**	**0.39**	**0.25**	**NS**	**48**	**NS**	**1.94**	**0.11**	**0.26**	**NS**

μScm^{-1} to V_2T_1 - 21.85 μScm^{-1}), mean germination time (V_2T_6 - 2.44 days to V_1T_6 - 2.82 days) and time taken for 50% germination (V_2T_6 - 1.85 days to V_1T_3 and V_2T_1 - 2.23 days). The seeds used for the study were found to be free of seed infection.

4.3.1 Seed quality during storage

4.3.1.1 Germination (%)

The results on germination per cent as influenced by varieties, various potassium levels, and their interaction effects during the storage period are enumerated in Table 23 and 24.

Germination did not vary significantly between the varieties during the storage period. Germination declined progressively over the storage period. Germination in Saubhagya reduced from 97.67 to 89.50 per cent while it reduced from 96.83 to 88.83 per cent in Mudicode. The varieties maintained the IMSCS prescribed standard of seed germination for seed certification (60.00% for melon) till the end of storage period.

The levels of potassium nutrition significantly influence the germination (%) during storage. Germination declined progressively over the storage period in all the treatments irrespective of the varieties. At 1 MAS, seeds collected from the treatment T_5 (POP + 0.5% FS; 99.00%) registered the highest germination and was significantly different from all other treatments. Treatment T_2 (No K; 93.00 %) and T_6 (Organic POP; 93.00 %) registered the least values. At the end of the storage period (6 MAS), T_3 (POP + 25% K; 91.00 %), T_4 (POP + 50% K; 92.00 %) and T_5 (POP + 0.5% FS; 90.50 %) were found to be on par with each other, but differed significantly from all other treatments. Treatment T_2 (No K; 59.97 %) registered the least germination.

In general, seeds collected from the treatments, T_4 (POP + 50% K), T_5 (POP + 0.5% FS) and T_3 (POP + 25% K) exhibited superior germination as compared to other treatments throughout storage.

Table 23: Influence of varieties and nutrient levels on germination (%) during storage in oriental pickling melon

Details	Months after storage (MAS)							
	1 MAS	2 MAS	3 MAS	4 MAS	5 MAS	6 MAS	Mean	Per cent reduction
Varieties								
V_1 - Saubhagya	95.67 (74.27)	94.83 (72.02)	93.50 (69.51)	92.83 (68.45)	91.50 (66.48)	89.50 (63.76)	92.97	8.37
V_2 - Mudicode	95.50 (73.96)	94.50 (71.46)	93.83 (70.26)	92.50 (68.46)	91.50 (66.53)	88.83 (62.81)	92.78	8.26
CD (0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**		
Potassium levels								
T_1 – POP	94.50 (71.01)	94.50 (71.01)	93.50 (69.31)	92.00 (67.20)	91.50 (66.36)	87.50 (61.09)	92.25	8.85
T_2 – No K	93.00 (68.52)	91.00 (65.58)	91.00 (65.58)	90.00 (64.25)	89.00 (62.93)	86.50 (59.97)	90.08	8.95
T_3 – POP + 25%K	97.00 (76.17)	96.50(74.97)	95.00 (71.93)	93.50 (69.95)	92.50 (67.74)	91.00 (65.58)	94.25	8.08
T_4 – POP + 50%K	97.00 (76.17)	96.50 (74.97)	96.00 (74.05)	95.50 (73.13)	94.00 (70.23)	92.00 (67.05)	95.17	5.64
T_5 – POP + 0.5% FS	99.00 (84.30)	97.00 (76.17)	95.50 (72.86)	95.00 (71.93)	93.50 (69.45)	90.50 (64.88)	95.08	9.5
T_6 – Organic POP	93.00 (68.52)	92.50 (67.74)	91.00 (65.58)	90.00 (64.25)	88.50 (62.30)	87.50 (61.14)	90.42	8.85
CD (0.05)	**6.42**	**2.11**	**1.80**	**2.01**	**4.02**	**2.38**		

Table 24: Interaction effect varieties and nutrient levels on germination (%) during storage in oriental pickling melon

Treatments	Months after storage (MAS)					
	1 MAS	**2 MAS**	**3 MAS**	**4 MAS**	**5 MAS**	**6 MAS**
Interaction (V× T)						
V_1T_1	95.00 (71.93)	95.00 (71.93)	94.00 (70.09)	93.00 (68.52)	92.00 (67.14)	88.00 (61.67)
V_1T_2	93.00 (68.52)	91.00 (65.58)	91.00 (65.58)	90.00 (64.19)	89.00 (62.93)	85.00 (58.26)
V_1T_3	97.00 (76.17)	97.00 (76.17)	95.00 (71.93)	93.00 (68.52)	93.00 (68.52)	91.00 (65.58)
V_1T_4	97.00 (76.17)	96.00 (73.78)	95.00 (71.93)	95.00 (71.93)	94.00 (70.37)	93.00 (68.52)
V_1T_5	99.00 (84.30)	97.00 (76.17)	95.00 (71.93)	95.00 (71.93)	92.00 (66.96)	91.00 (65.58)
V_1T_6	93.00 (68.52)	93.00 (68.52)	91.00 (65.58)	91.00 (65.58)	89.00 (62.93)	89.00(62.93)
V_2T_1	94.00 (70.09)	94.00 (70.09)	93.00 (68.52)	91.00 (65.88)	91.00 (65.58)	87.00 (60.51)
V_2T_2	93.00 (68.52)	91.00 (65.58)	91.00 (65.58)	90.00 (64.32)	89.00 (62.93)	88.00 (61.67)
V_2T_3	97.00 (76.17)	96.00 (73.78)	95.00 (71.93)	94.00 (71.38)	92.00 (66.96)	91.00 (65.58)
V_2T_4	97.00 (76.17)	97.00 (76.17)	97.00 (76.17)	96.00 (74.32)	94.00 (70.09)	91.00 (65.58)
V_2T_5	99.00 (84.30)	97.00 (76.17)	96.00 (73.78)	95.00 (71.93)	95.00 (71.93)	90.00 (64.19)
V_2T_6	93.00 (68.52)	92.00 (66.96)	91.00 (65.58)	89.00 (62.93)	88.00 (61.67)	86.00 (59.35)
CD (0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

4.3.1.2 Mean germination time (MGT)

The results obtained on mean germination time as influenced by varieties, various nutrient levels, and their interaction effects during the storage period are presented in Table 25 and 26.

The mean germination time of seeds of Mudicode variety was found to be low and significantly superior over Saubhagya during first three months of storage. The mean germination time was initially low in V_1 (2.68 days) and V_2 (2.57 days) while, it increased towards the end of storage reaching 7.03 days in Saubhagya and 7.05 days in Mudicode.

Seeds collected from T_5 (POP + 0.5% FS) followed by T_6 (Organic POP), T_3 (POP + 25% K) and T_4 (POP + 50% K) recorded the least value for mean germination time and was found to be superior over all other treatments at the end of storage. At the end of the storage period, mean germination time of 6.96 days, 6.98 days and 7.01 days were registered for these treatments, T_5, T_6, and T_3 respectively. The highest mean germination time of 7.19 days at the end of the storage period was recorded under the treatment, T_2 (POP without K) followed by T_1 (7.07 days).

Mean germination time was significantly influenced by the interaction between varieties and levels of potassium except at 6 MAS. During 5 MAS, Mean germination time varied from 6.45 days (V_2T_2) to 6.68 days (V_2T_4). V_2T_2 was found to be on par with V_2T_3 (6.46 days), V_1T_4 (6.52 days) and V_1T_6 (6.52 days).

4.3.1.3 Time taken for 50% germination (T_{50})

The results recorded on time taken for 50% germination as influenced by varieties, different potassium levels, and their interaction effects during the storage period are enumerated in Table 27 and 28.

Table 25: Influence of levels varieties and nutrient levels on mean germination time (MGT) during storage in oriental pickling melon

Details	Months after storage (MAS)							
	1 MAS	2 MAS	3 MAS	4 MAS	5 MAS	6 MAS	Mean	Per cent increase
Varieties								
V_1 - Saubhagya	2.91	3.60	3.72	5.45	6.56	7.03	4.88	162.31
V_2 - Mudicode	2.68	3.21	3.47	5.49	6.54	7.05	4.74	174.32
CD (0.05)	**0.04**	**0.05**	**0.07**	**NS**	**NS**	**NS**		
Potassium levels								
T_1 – POP	2.83	3.51	3.83	4.88	6.53	7.07	4.78	166.79
T_2 – No K	2.74	3.44	3.25	5.47	6.50	7.19	4.77	175.48
T_3 – POP + 25%K	2.79	3.17	3.65	5.72	6.54	7.01	4.81	162.55
T_4 – POP + 50%K	2.86	3.35	3.82	5.82	6.60	7.03	4.91	171.43
T_5 – POP + 0.5% FS	2.66	3.43	3.61	5.71	6.58	6.96	4.83	165.65
T_6 – Organic POP	2.87	3.53	3.42	5.24	6.58	6.98	4.77	165.40
CD (0.05)	**0.08**	**0.09**	**0.11**	**0.08**	**0.05**	**0.06**		

Table 26: Interaction effect of varieties and nutrient levels on mean germination time (MGT) during storage in oriental pickling melon

Treatments	Months after storage (MAS)					
	1 MAS	**2 MAS**	**3 MAS**	**4 MAS**	**5 MAS**	**6 MAS**
			Interaction (V× T)			
V_1T_1	2.81	3.58	4.02	4.34	6.60	7.09
V_1T_2	2.76	4.14	3.53	5.57	6.54	7.19
V_1T_3	2.97	3.15	4.03	5.89	6.63	6.99
V_1T_4	2.86	3.38	3.99	6.24	6.52	7.05
V_1T_5	2.79	3.53	3.53	5.53	6.59	6.95
V_1T_6	3.25	3.83	3.24	5.15	6.52	6.95
V_2T_1	2.85	3.44	3.63	5.42	6.45	7.06
V_2T_2	2.72	2.74	2.96	5.37	6.45	7.19
V_2T_3	2.62	3.19	3.26	5.56	6.46	7.02
V_2T_4	2.86	3.33	3.65	5.40	6.68	7.02
V_2T_5	2.54	3.33	3.69	5.89	6.57	6.98
V_2T_6	2.48	3.23	3.60	5.33	6.65	7.01
CD (0.05)	**0.11**	**0.13**	**0.16**	**0.11**	**0.07**	**NS**

Table 27: Influence of varieties and nutrient levels on time taken for 50% germination (T_{50}) during storage in oriental pickling melon

Details	Months after storage (MAS)							
	1 MAS	**2 MAS**	**3 MAS**	**4 MAS**	**5 MAS**	**6 MAS**	**Mean**	**Per cent increase**
Varieties								
V_1 - Saubhagya	2.27	2.60	2.79	4.90	5.81	6.59	4.16	213.80
V_2 - Mudicode	2.07	2.11	2.36	4.90	5.78	6.68	3.98	230.69
CD (0.05)	**0.13**	**0.23**	**0.43**	**NS**	**NS**	**NS**		
Potassium levels								
T_1 – POP	2.24	2.34	3.11	4.51	5.76	6.32	4.05	203.85
T_2 – No K	2.21	2.63	2.25	4.88	5.40	6.58	3.99	216.35
T_3 – POP + 25%K	2.14	2.28	2.67	5.15	5.86	6.66	4.13	215.64
T_4 – POP + 50%K	2.20	2.21	2.59	5.13	6.04	6.78	4.16	227.54
T_5 – POP + 0.5% FS	2.10	2.22	2.43	5.14	6.01	6.82	4.12	227.88
T_6 – Organic POP	2.14	2.45	2.41	4.58	5.69	6.64	3.99	240.51
CD (0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**		

Table 28: Interaction effect of varieties and nutrient levels on time taken for 50% germination (T_{50}) during storage in oriental pickling melon

Treatments	Months after storage (MAS)					
	1 MAS	2 MAS	3 MAS	4 MAS	5 MAS	6 MAS
Interaction (V× T)						
V_1T_1	2.24	2.61	3.00	3.73	5.93	6.30
V_1T_2	2.22	3.40	2.64	5.20	5.30	6.35
V_1T_3	2.27	2.15	3.42	4.89	6.28	6.65
V_1T_4	2.28	2.31	2.58	5.81	5.98	6.80
V_1T_5	2.17	2.13	2.70	5.18	5.61	6.83
V_1T_6	2.45	2.97	2.39	4.58	5.75	6.61
V_2T_1	2.24	2.06	3.21	5.29	5.58	6.34
V_2T_2	2.21	1.86	1.86	4.57	5.50	6.81
V_2T_3	2.01	2.41	1.91	5.41	5.44	6.67
V_2T_4	2.11	2.11	2.60	4.44	6.10	6.75
V_2T_5	2.03	2.31	2.16	5.10	6.41	6.81
V_2T_6	1.83	1.93	2.43	4.57	5.63	6.67
CD (0.05)	**NS**	**0.57**	**NS**	**1.02**	**NS**	**NS**

The time taken for 50% germination of seeds of Mudicode variety recorded the least value and significantly superior over seeds of Saubhagya during first three months of storage.

Time taken for 50% germination was initially low in both the varieties (V_1: 2.10 days and V_2 : 2.02 days) and increased towards the end of storage reaching, 6.59 days in Saubhagya and 6.68 days in Mudicode. Considering the interaction, time taken for 50% germination was significant only during second and fourth month of storage. V_2T_2 was found to superior to all the other treatments for the time taken for 50% germination.

4.3.1.4 Seedling shoot length (cm)

The results recorded on shoot length as influenced by varieties, various nutrient levels, and their interaction effects during the storage period are enumerated in Table 29 and 30.

Mudicode variety recorded the highest seedling shoot length throughout the storage period. Shoot length in Saubhagya reduced from 20.04 to 13.29 cm while it gets reduced from 20.01 to 14.56 cm in Mudicode.

Seeds collected from T_5 (POP + 0.5% FS) followed by T_3 (POP + 25% K), T_4 (POP + 50% K) and T_6 (Organic POP) was found to be superior at the end of the storage period. Seedling shoot length of 14.39 cm, 14.28 cm, 14.27 cm, 14.18 cm was observed under the treatments, T_5, T_3, T_4 and T_6 at the end of six months of storage respectively. POP without K (13.13 cm) followed by POP (13.32 cm) recorded the least value for shoot length among the nutrient levels.

At the end of storage, V_2T_4 (15.76 cm), V_2T_3 (15.70 cm), V_2T_6 (15.69 cm), V_2T_5 (15.30 cm) recorded high values for shoot length while lowest shoot length was recorded in V_2T_1 (12.20 cm) which was on par with V_1T_6, V_2T_2, V_1T_4, V_1T_3, and V_1T_5.

Table 29: Influence of varieties and nutrient levels on seedling shoot length (cm) during storage in oriental pickling melon

Details	Months after storage (MAS)							
	1 MAS	2 MAS	3 MAS	4 MAS	5 MAS	6 MAS	Mean	Per cent reduction
Varieties								
V_1 - Saubhagya	19.13	17.78	16.30	14.83	14.18	13.29	15.92	33.68
V_2 - Mudicode	19.31	19.01	18.34	17.68	16.32	14.56	17.54	27.24
CD (0.05)	**NS**	**0.48**	**0.53**	**0.44**	**0.67**	**0.53**		
Potassium levels								
T_1 – POP	17.94	17.54	16.74	15.65	14.75	13.32	15.99	30.76
T_2 – No K	19.75	18.93	17.13	15.74	14.73	13.13	16.57	35.95
T_3 – POP + 25%K	19.79	18.84	17.69	16.92	15.18	14.28	17.12	29.79
T_4 – POP + 50%K	19.46	17.84	17.31	16.75	15.78	14.27	16.90	29.11
T_5 – POP + 0.5% FS	19.15	18.61	17.86	16.18	15.74	14.39	16.99	28.19
T_6 – Organic POP	19.24	18.60	17.18	16.29	15.30	14.18	16.80	28.67
CD (0.05)	**0.66**	**0.83**	**NS**	**0.77**	**NS**	**0.91**		

Table 30: Interaction effect of varieties and nutrient levels on seedling shoot length (cm) during storage in oriental pickling melon

Treatments	Months after storage (MAS)					
	1 MAS	2 MAS	3 MAS	4 MAS	5 MAS	6 MAS
Interaction (V× T)						
V_1T_1	18.46	18.19	17.62	16.13	15.39	14.45
V_1T_2	20.20	18.69	16.34	15.19	14.81	13.54
V_1T_3	19.37	17.60	15.72	14.63	13.12	12.85
V_1T_4	18.94	15.79	15.37	14.51	13.79	12.77
V_1T_5	18.63	18.21	17.18	14.14	14.26	13.49
V_1T_6	19.21	18.18	15.57	14.40	13.71	12.67
V_2T_1	17.41	16.89	15.87	15.18	14.11	12.20
V_2T_2	19.30	19.17	17.93	16.30	14.65	12.72
V_2T_3	20.22	20.09	19.67	19.21	17.25	15.70
V_2T_4	19.98	19.88	19.24	19.00	17.77	15.76
V_2T_5	19.67	19.01	18.55	18.22	17.22	15.30
V_2T_6	19.27	19.02	18.79	18.18	16.90	15.69
CD (0.05)	**0.93**	**1.17**	**1.30**	**1.09**	**1.65**	**1.29**

4.3.1.5 Seedling root length (cm)

The results ascertained in root length as influenced by varieties, various nutrient levels, and their interaction effects during the storage period are enumerated in Table 31 and 32.

The seedling root length of Saubhagya variety was found to be high throughout the storage period. Root length in V_1 (Saubhagya) reduced from 10.34 to 6.05 cm while it reduced from 6.64 to 5.20 cm in V_2 (Mudicode).

Seeds collected from T_6 (organic POP) followed by T_5 (POP + 0.5% FS), T_2 (POP without K) and T_4 (POP + 50% K) were found to be superior for root length during storage. At the end of storage T_4 (5.93 cm) and T_6 (5.89 cm) recorded higher values for root length while T_3 (POP + 25% K) followed by T_1 (POP) recorded the least values (5.24 and 5.33 cm).

V_1T_4 recorded a root length of 6.65 cm which was on par with V_1T_6 (6.48 cm) followed by V_1T_5 (6.15 cm) and V_1T_2 (6.12 cm) at the end of the storage period. The least value for root length at the end of the storage was recorded in V_2T_3 (5.05 cm) which was on par with V_2T_2 (5.11 cm), V_2T_1 (5.21 cm) and V_2T_4 (5.21 cm).

4.3.1.6 Seedling dry weight (g)

The data obtained on seedling dry weight as influenced by varieties, various fertilizer levels, and their interaction effects during the storage period is enumerated in Table 33 and 34.

The dry weight in V_1 (Saubhagya) reduced from 0.027 to 0.020 g while it gets reduced from 0.025 to 0.016 g in V_2 (Mudicode). Irrespective of different nutrient levels, there existed no variation in the dry matter production of the seedlings during the experiment span with the general trend showing a decline with the advancement of storage period. V_1T_1 was superior among the treatment combinations throughout the storage period.

Table 31: Influence of varieties and nutrient levels on seedling root length (cm) during storage in oriental pickling melon

Details	Months after storage (MAS)							
	1 MAS	2 MAS	3 MAS	4 MAS	5 MAS	6 MAS	Mean	Per cent reduction
Varieties								
V_1 - Saubhagya	9.97	9.06	7.63	6.63	6.23	6.05	7.60	41.49
V_2 - Mudicode	6.23	5.56	5.57	5.31	5.29	5.20	5.53	21.69
CD (0.05)	**0.14**	**0.21**	**0.14**	**0.50**	**0.12**	**0.09**		
Potassium levels								
T_1 – POP	8.04	7.19	6.51	5.72	5.61	5.33	6.40	35.63
T_2 – No K	8.27	7.43	6.89	5.95	5.70	5.62	6.64	33.80
T_3 – POP + 25%K	7.55	6.57	6.11	5.48	5.32	5.24	6.05	35.55
T_4 – POP + 50%K	7.63	6.81	6.37	6.04	6.00	5.93	6.46	25.97
T_5– POP + 0.5% FS	8.34	7.84	6.91	6.24	5.88	5.72	6.82	34.70
T_6 – Organic POP	8.76	8.01	6.81	6.38	6.03	5.89	6.98	36.46
CD (0.05)	**0.25**	**0.36**	**0.25**	**NS**	**0.21**	**0.15**		

Table 32: Interaction effect of varieties and nutrient levels on seedling root length (cm) during storage in oriental pickling melon

Treatments	Months after storage (MAS)					
	1 MAS	**2 MAS**	**3 MAS**	**4 MAS**	**5 MAS**	**6 MAS**
Interaction (V× T)						
V_1T_1	9.75	8.60	7.52	6.33	5.89	5.46
V_1T_2	10.19	9.26	8.28	6.62	6.20	6.12
V_1T_3	9.36	8.36	7.20	5.95	5.65	5.42
V_1T_4	9.72	8.40	7.26	6.78	6.73	6.65
V_1T_5	10.44	9.61	7.57	6.86	6.25	6.15
V_1T_6	10.37	10.14	7.94	7.25	6.67	6.48
V_2T_1	6.34	5.78	5.50	5.11	5.33	5.21
V_2T_2	6.35	5.61	5.50	5.29	5.21	5.11
V_2T_3	5.75	4.78	5.03	5.01	5.00	5.05
V_2T_4	5.54	5.21	5.49	5.30	5.28	5.21
V_2T_5	6.23	6.07	6.25	5.63	5.51	5.30
V_2T_6	7.15	5.89	5.68	5.51	5.40	5.31
CD (0.05)	**0.35**	**0.50**	**0.35**	**NS**	**0.30**	**0.22**

Table 33: Influence of varieties and nutrient levels on seedling dry weight (g) in oriental pickling melon

Details	Months after storage (MAS)							
	1 MAS	**2 MAS**	**3 MAS**	**4 MAS**	**5 MAS**	**6 MAS**	**Mean**	**Per cent reduction**
Varieties								
V_1 - Saubhagya	0.025	0.026	0.024	0.023	0.021	0.020	0.023	25.92
V_2 - Mudicode	0.023	0.021	0.019	0.018	0.017	0.016	0.019	36.00
CD (0.05)	**NS**	**0.002**	**0.002**	**0.001**	**0.002**	**0.001**		
Potassium levels								
T_1 – POP	0.023	0.023	0.022	0.020	0.019	0.018	0.021	28.00
T_2 – No K	0.024	0.023	0.021	0.020	0.019	0.018	0.021	30.77
T_3 – POP + 25%K	0.025	0.024	0.022	0.021	0.020	0.018	0.022	33.33
T_4 – POP + 50%K	0.023	0.022	0.021	0.020	0.018	0.018	0.020	28.00
T_5 – POP + 0.5% FS	0.027	0.025	0.022	0.020	0.020	0.018	0.022	37.93
T_6 – Organic POP	0.022	0.021	0.020	0.020	0.019	0.017	0.020	29.17
CD (0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**		

Table 34: Interaction effect of varieties and nutrient levels on seedling dry weight (g) in oriental pickling melon

Treatments	Months after storage (MAS)					
	1 MAS	2 MAS	3 MAS	4 MAS	5 MAS	6 MAS
Interaction (V× T)						
V_1T_1	0.026	0.027	0.026	0.024	0.022	0.021
V_1T_2	0.025	0.026	0.024	0.022	0.021	0.020
V_1T_3	0.026	0.026	0.024	0.023	0.021	0.020
V_1T_4	0.024	0.025	0.023	0.022	0.021	0.020
V_1T_5	0.025	0.026	0.024	0.023	0.022	0.020
V_1T_6	0.024	0.025	0.023	0.022	0.021	0.020
V_2T_1	0.020	0.019	0.018	0.016	0.017	0.015
V_2T_2	0.023	0.021	0.018	0.018	0.017	0.016
V_2T_3	0.025	0.023	0.020	0.020	0.019	0.017
V_2T_4	0.021	0.020	0.018	0.017	0.016	0.016
V_2T_5	0.030	0.024	0.020	0.018	0.018	0.015
V_2T_6	0.019	0.018	0.017	0.017	0.017	0.015
CD (0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

4.3.1.7 Vigour index- I

The results on vigour index I as influenced by varieties, various nutrient levels, and their interaction effects during the storage period are furnished in Table 29 and 30.

The seedling vigour index I of Mudicode seeds were significantly superior over the seeds of Saubhagya at the end of the storage period. The seedling vigour index I of V_1 (Saubhagya) reduced from 2972 to 1730 while it reduced from 2972 to 1778 in V_2 (Mudicode).

Seeds collected from T_5 (POP + 0.5% FS) followed by T_4 (POP + 50% K), T_3 (POP + 25% K) and T_6 (Organic POP), was found to be superior over all other treatments at the end of storage. Seedling vigour index of 1857, 1825, 1792 and 1781 was observed under the treatments, T_4, T_5, T_6 and T_3 at the end of six months of storage period respectively. Least vigour index I of 1629 at the end of storage period was recorded under the treatment, T_2 (POP without K) which was on par with T_1 (1642).

The lowest seedling vigour index I was recorded under the treatment combination, V_2T_1 (1532) which was on par with V_2T_2 (1586), V_1T_3 (1663), and V_1T_2 (1752).

4.3.1.8 Vigour index II

The results ascertained on seedling vigour index II as influenced by varieties, various nutrient levels, and their interaction effects during the storage period are enumerated in Table 37 and 38.

The seedling vigour index II of Saubhagya variety was high and significantly superior over Mudicode throughout the storage period. The seedling vigour index II was found to decrease from 2626 to 1807 in V_1 (Saubhagya) while it gets reduced from 2423 to 1398 in V_2 (Mudicode).

Table 35: Influence of varieties and nutrient levels on seedling vigour index-I (VI-I) in oriental pickling melon

Details	Months after storage (MAS)							
	1 MAS	2 MAS	3 MAS	4 MAS	5 MAS	6 MAS	Mean	Per cent reduction
Varieties								
V_1 - Saubhagya	2769	2523	2236	1988	1878	1730	2187	41.79
V_2 - Mudicode	2447	2326	2241	2120	1978	1778	2148	40.17
CD (0.05)	**47**	**62**	**NS**	**72**	**77**	**NS**		
Potassium levels								
T_1 – POP	2455	2324	2163	1961	1842	1642	2065	42.51
T_2 – No K	2597	2398	2174	1952	1839	1629	2098	45.32
T_3 – POP + 25%K	2652	2459	2267	2094	1905	1781	2193	40.85
T_4 – POP + 50%K	2648	2360	2268	2148	2041	1857	2220	37.93
T_5 – POP + 0.5% FS	2685	2544	2366	2119	2010	1825	2258	39.43
T_6 – Organic POP	2610	2463	2194	2050	1931	1792	2173	39.85
CD (0.05)	**81**	**108**	**96**	**125**	**133**	**101**		

Table 36: Interaction effect of varieties and nutrient levels on seedling vigour index-I (VI-I) in oriental pickling melon

Treatments	Months after storage (MAS)					
	1 MAS	2 MAS	3 MAS	4 MAS	5 MAS	6 MAS
Interaction (V× T)						
V_1T_1	2666	2518	2338	2066	1925	1752
V_1T_2	2796	2529	2228	1963	1880	1671
V_1T_3	2786	2505	2176	1924	1765	1663
V_1T_4	2809	2298	2150	2011	1939	1806
V_1T_5	2806	2657	2351	1985	1907	1786
V_1T_6	2750	2634	2173	1980	1855	1704
V_2T_1	2244	2131	1987	1856	1760	1532
V_2T_2	2398	2267	2120	1941	1798	1586
V_2T_3	2518	2412	2358	2263	2046	1899
V_2T_4	2487	2421	2386	2284	2143	1908
V_2T_5	2564	2432	2381	2254	2114	1864
V_2T_6	2470	2291	2214	2120	2007	1879
CD (0.05)	**NS**	**152**	**136**	**176**	**188**	**143**

Table 37: Influence of varieties and nutrient levels on seedling vigour index-II (VI-II) during in oriental pickling melon

Details	Months after storage (MAS)							
	1 MAS	2 MAS	3 MAS	4 MAS	5 MAS	6 MAS	Mean	Per cent reduction
Varieties								
V_1 - Saubhagya	2375	2421	2246	2091	1961	1807	2150	31.19
V_2 - Mudicode	2213	1983	1736	1647	1569	1398	1758	42.30
CD (0.05)	**NS**	**171**	**205**	**141**	**143**	**125**		
Potassium levels								
T_1 – POP	2147	2162	2051	1832	1753	1585	1922	32.52
T_2 – No K	2240	2126	1895	1813	1670	1546	1882	36.80
T_3 – POP + 25%K	2441	2360	2118	2008	1870	1684	2080	37.56
T_4 – POP + 50%K	2232	2148	1975	1854	1725	1662	1933	32.88
T_5 – POP + 0.5% FS	2675	2429	2084	1933	1832	1597	2092	44.72
T_6 – Organic POP	2026	1988	1823	1774	1739	1543	1816	46.79
CD (0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**		

Table 38: Interaction effect of varieties and nutrient levels on seedling vigour index-II (VI-II) in oriental pickling melon

Treatments	Months after storage (MAS)					
	1 MAS	2 MAS	3 MAS	4 MAS	5 MAS	6 MAS
Interaction (V× T)						
V_1T_1	2414	2500	2409	2162	1968	1813
V_1T_2	2301	2311	2171	1985	1844	1688
V_1T_3	2484	2513	2324	2127	2016	1838
V_1T_4	2393	2399	2197	2100	2003	1887
V_1T_5	2389	2502	2239	2154	2004	1843
V_1T_6	2267	2301	2138	2018	1928	1775
V_2T_1	1881	1824	1694	1501	1538	1357
V_2T_2	2180	1940	1620	1641	1497	1404
V_2T_3	2398	2207	1913	1889	1725	1530
V_2T_4	2070	1897	1753	1609	1446	1436
V_2T_5	2961	2356	1930	1712	1660	1351
V_2T_6	1786	1674	1509	1530	1550	1310
CD (0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

4.1.3.9 Electrical conductivity (EC) of seed leachate (μScm^{-1})

The results pertaining to the electrical conductivity of seed leachate as influenced by varieties, various nutrient levels and their interaction effects during the storage period are enumerated in Table 39 and 40.

The electrical conductivity of seed leachate was observed to increase with the increase in storage period. The electrical conductivity of seed leachate of Mudicode variety was found to be low and significantly superior over Saubhagya throughout the storage period. The electrical conductivity of seed leachate was observed to increase from 17.88 to 23.90 μScm^{-1} in V_1 (Saubhagya) while it gets increased from 17.47 to 14.56 μScm^{-1} in V_2 (Mudicode).

Seeds collected from T_2 (POP + 0.5% FS) followed by T_3 (POP + 25% K), recorded least value for electrical conductivity of seed leachate and was found to be superior over all other treatments at the end of storage. The highest electrical conductivity of seed leachate of 49.28 μScm^{-1} at the end of the storage period was recorded by the treatment, T_1 (POP) followed by T_6 (47.33μScm^{-1}).

V_2T_4 was superior to all other treatments for electrical conductivity of seed leachate throughout the storage period. The highest electrical conductivity of seed leachate was observed in V_1T_1 (72.20 μScm^{-1}).

4.3.1.10 Seed moisture (%)

The results on seed moisture as influenced by varieties, nutrient levels, and their interaction are furnished in Table 41 and 42. The data revealed that varieties, nutrient levels and their interaction between varieties and nutrient levels were found to be non - significant.

Table 39: Influence of varieties and nutrient levels on electrical conductivity of seed leachate (μScm^{-1}) in oriental pickling melon

Details	Months after storage (MAS)							
	1 MAS	**2 MAS**	**3 MAS**	**4 MAS**	**5 MAS**	**6 MAS**	**Mean**	**Per cent increase**
Varieties								
V_1 - Saubhagya	20.68	28.05	37.24	48.12	58.08	68.38	43.43	28.20
V_2 - Mudicode	19.52	21.24	21.87	22.61	23.14	23.90	22.05	36.80
CD (0.05)	**NS**	**0.77**	**1.04**	**0.84**	**1.14**	**0.50**		
Potassium levels								
T_1 – POP	22.85	26.18	29.30	34.68	43.49	49.28	34.30	132
T_2 – No K	17.40	21.35	25.53	32.61	37.01	43.53	29.57	185
T_3 – POP + 25%K	21.53	25.58	30.10	35.14	40.72	45.97	33.17	132
T_4 – POP + 50%K	16.80	23.49	29.04	35.66	41.36	44.53	31.81	195
T_5 – POP + 0.5% FS	19.88	24.24	31.14	38.36	39.19	46.18	33.17	179
T_6 – Organic POP	22.13	27.05	32.25	35.74	41.91	47.33	34.40	160
CD (0.05)	**2.29**	**1.34**	**1.80**	**1.46**	**1.97**	**0.86**		

Table 40: Interaction effect of varieties and nutrient levels on electrical conductivity of seed leachate (μScm^{-1}) in oriental pickling melon

Treatments	Months after storage (MAS)					
	1 MAS	2 MAS	3 MAS	4 MAS	5 MAS	6 MAS
Interaction (V× T)						
V_1T_1	23.00	28.35	33.65	43.30	60.85	72.20
V_1T_2	16.90	22.70	29.50	43.30	50.95	63.15
V_1T_3	22.75	29.20	38.00	47.75	58.40	68.10
V_1T_4	16.95	29.15	40.15	52.00	62.60	67.05
V_1T_5	22.50	28.70	41.65	54.90	56.20	69.95
V_1T_6	21.95	30.20	40.50	47.45	59.50	69.80
V_2T_1	22.69	24.00	24.95	26.05	26.14	26.35
V_2T_2	17.90	20.00	21.55	21.92	23.07	23.91
V_2T_3	20.30	21.95	22.20	22.53	23.03	23.84
V_2T_4	16.65	17.83	17.92	19.31	20.12	22.02
V_2T_5	17.27	19.78	20.62	21.82	22.18	22.41
V_2T_6	22.30	23.90	24.00	24.02	24.32	24.87
CD (0.05)	**NS**	**1.90**	**2.06**	**2.06**	**2.78**	**1.22**

4.3.1.11 Seed infection (%)

The results of seed infection as influenced by varieties, nutrient levels, and their interaction effects during the storage period are enumerated in Table 41 and 42. The seed infection varied from 1.00 per cent in T_3 (POP + 25% K) and T_6 (POP + 0.5% FS) to 7.00 per cent in T_2 (POP without K) at the end of the storage period. The lowest seed infection was observed under the treatment, POP + 25% K (1.00 %) and organic POP (1.00 %) while the highest seed infection was observed in POP without K (7.00 %) at the end of storage period.

The seed infection varied from 0.00 per cent to 10.00 per cent at the end of the storage period. No seed infection was recorded in V_1T_3 and V_2T_6 while highest seed infection among the treatment combination was observed inV_1T_2 (10.00 %) and V_1T_4 (10.00 %). Seed micro flora observed as *Aspergillus* sp. and *Curvularia* sp.

Table 41: Influence of varieties and nutrient levels on seed micro flora (%) and seed moisture (%) in oriental pickling melon at the end of storage period

Details	**Seed micro flora (%)**	**Seed moisture (%)**
Varieties		
V_1 - Saubhagya	5.00	6.14
V_2 - Mudicode	2.33	6.13
CD (0.05)	**NS**	**NS**
Potassium levels		
T_1 – POP	3.00	6.17
T_2 – No K	7.00	6.1
T_3 – POP + 25%K	1.00	6.15
T_4 – POP + 50%K	7.00	6.15
T_5 – POP + 0.5% FS	3.00	6.15
T_6 – Organic POP	1.00	6.09
CD (0.05)	**4.76**	**NS**

Table 42: Interaction effect of varieties and nutrient levels on seed micro flora (%) and seed moisture (%) in oriental pickling melon at the end of storage period

Treatments	Seed micro flora (%)	Seed moisture (%)
Interaction (V× T)		
V_1T_1	4.00	6.14
V_1T_2	10.00	6.10
V_1T_3	0.01	6.18
V_1T_4	10.00	6.19
V_1T_5	4.00	6.15
V_1T_6	2.00	6.10
V_2T_1	2.00	6.20
V_2T_2	4.00	6.10
V_2T_3	2.00	6.13
V_2T_4	4.00	6.12
V_2T_5	2.00	6.15
V_2T_6	0.01	6.08
CD (0.05)	**NS**	**NS**

Discussion

5. DISCUSSION

Increasing population, rapid urbanization and shrinking land resources have increased the pressure to produce more food grain per unit area. Quality seed alone can increase the production up to 20 per cent, which is genetically and physically pure and free from pest and diseases. Seed sprouting during fruit development has been recognized as a serious problem affecting seed production.

Keeping this in view, an attempt was made to ascertain the effect of potassium nutrition and time of planting on vivipary and seed quality in oriental pickling melon. The insights of the study are furnished and discussed hereunder.

5.1 Effect of time of planting on fruit and seed yield attributes

5.1.1 Days taken for male flower emergence (days)

In the present investigation, there was a significant variation in days for male flower emergence with respect to interaction of planting dates and varieties. Results revealed that Saubhagya variety during the month of February produced male flowers early while December sown plants took comparatively more days. High temperature and long days might be the reason for early emergence of male flowers. Edmand (1930) reported that seasonal variation in sex expression of cucumber could be attributed to the change in day length. The February sown plants were exposed to high temperature than the earlier sown plants which resulted in early emergence of male flowers. Similar results were put forward by Pandit *et al*. (2010) and Morsey *et al*. (2016).

5.1.2 Days taken for female flower emergence (days)

Effect of varieties on days taken for first female flower opening was significant. Early flowering was recorded in Saubhagya variety, Khan (2001), Sharma *et al*. (2005), Mohamed (2012), Dash *et al.* (2013) Hossain (2014), Longjam and Bijaya devi (2017) and Ilyas *et al*. (2019) noted a significant varietal effect on days to female flower opening in okra, tinda gourd, pumpkin, tomato and cucumber respectively. These results were due to genetic variation among the varieties and their ability for exploiting the environmental factors under field conditions (Eifediyi and Remison, 2009).

The days for female emergence varied significantly among the different planting dates. This is in consonance with Agbaje (2012). It may be attributed to the direct relationship between the date of planting and temperature since cucurbits are thermo sensitive. The plants sown during December exhibit earliness in the onset of flowering than the later sowings. Saubhagya variety sown during December month flowered early than February sown crop was reported by Jamunadevi (2003). According to Kamalnathan and Thamburaj (1970), production of female flowers was favoured by cloudiness, temperature and day length which in turn affected the preflowering phase. December sowing experienced maximum cloudiness and lower temperature than other sowings. Effect of low temperature and day length on female flower production was reported by Narayanankutty *et al.* (2013), Nagendra *et al*. (2017) and Maragal *et al*. (2018) in cucurbits.

Influence of date of sowing on female flower production has been reported by Farooq (1992) in muskmelon, Murgeshan (2003), Elhag and Ahmed (2014) and Maragal *et al*. (2018) in cucumber, Nagendra *et al*. (2017) in oriental pickling melon, Amjad *et al*. (2001), Dash *et al*. (2013 and) Chawla *et al*. (2018) in okra, Khan *et al*. (2001) in tinda gourd, and Maragal (2016) in bittergourd.

The interaction effect of varieties and time of planting on the days to first female flower emergence was significant. Similar findings were reported by Longjam and Bijayadevi (2017). Early flowering in the present study was recorded by the treatment combination, $V_2 \times T_3$.

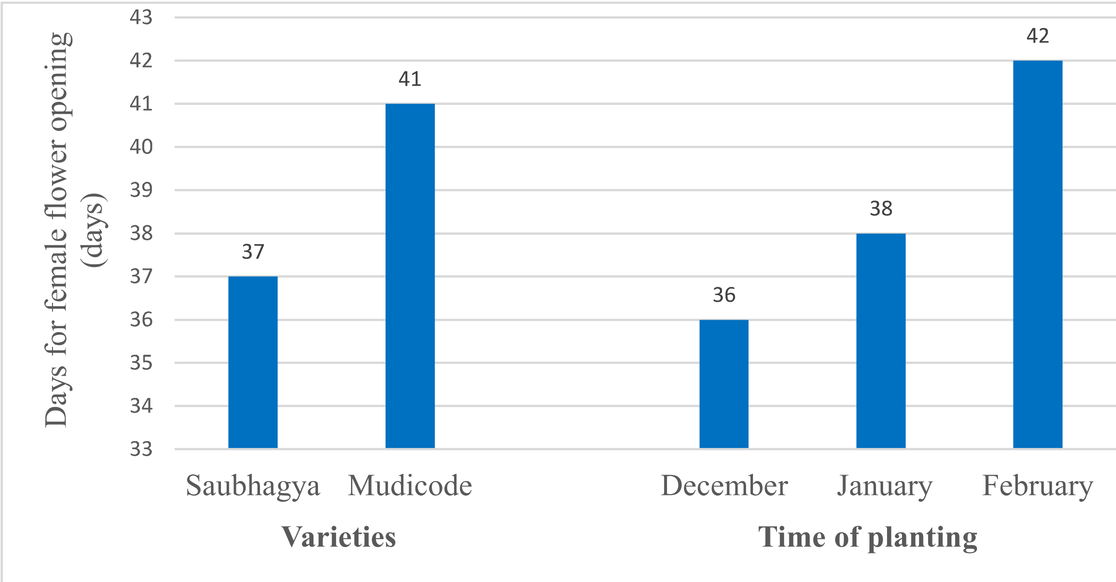


Fig. 1: Days to first female flower opening (days) as influenced by varieties and time of planting

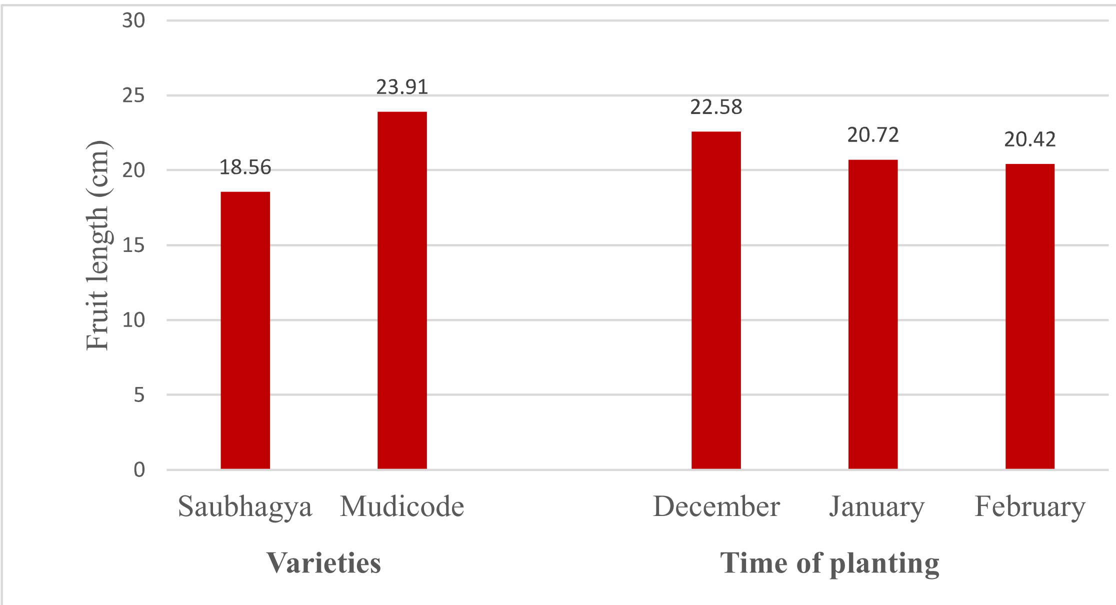


Fig. 2: Fruit length (cm) as influenced by varieties and time of planting

5.1.3 Fruit characters

5.1.3.1 Fruit length (cm)

Variation in fruit length was significant among varieties. High fruit length (23.91 cm) was recorded in Mudicode variety. Interaction effect between varieties and time of planting on fruit length was also significant. Higher values for fruit length was recorded in the variety Mudicode, planted during December. This may be due to the favourable climatic conditions for vigourous growth of the fruits prevailing during the growth period. The fruit length increased with the high relative humidity since it reduced the evaporation of moisture from soil and fruit surface which in turn resulted in better growth and development of fruits. The higher sunshine hours and lower minimum temperature experienced during pre-bearing period by December sowing may also contribute to increase in length. Similar findings were reported by Miller and Ries (1958), Longjam and Bijayadevi (2017), Nagendra (2017) and Chawla *et al.* (2018).The sowing dates exhibited no significant effect on fruit length, which is in consonance with Naz *et al.* (2009) in okra. In contrast to the present study, Eifediyi and Remison (2009) reported no significant differences between varieties with respect to fruit length.

5.1.3.2 Fruit girth (cm)

Variation in fruit girth was significant among the varieties and interaction between varieties and dates of planting. Among the varieties, Mudicode recorded higher value for fruit girth (26.46 cm). Eifediyi and Remison (2009) noticed varietal differences for this parameter in cucumber. Mudicode variety during December planting time recorded the highest fruit girth. The favourable climactic conditions prevailing during the month of December resulted in better fruit growth and development. Eifediyi and Remison (2009) reported that the variation might be due to genetic variation among the varieties and their ability for exploiting the enivironmental factors under field conditions.

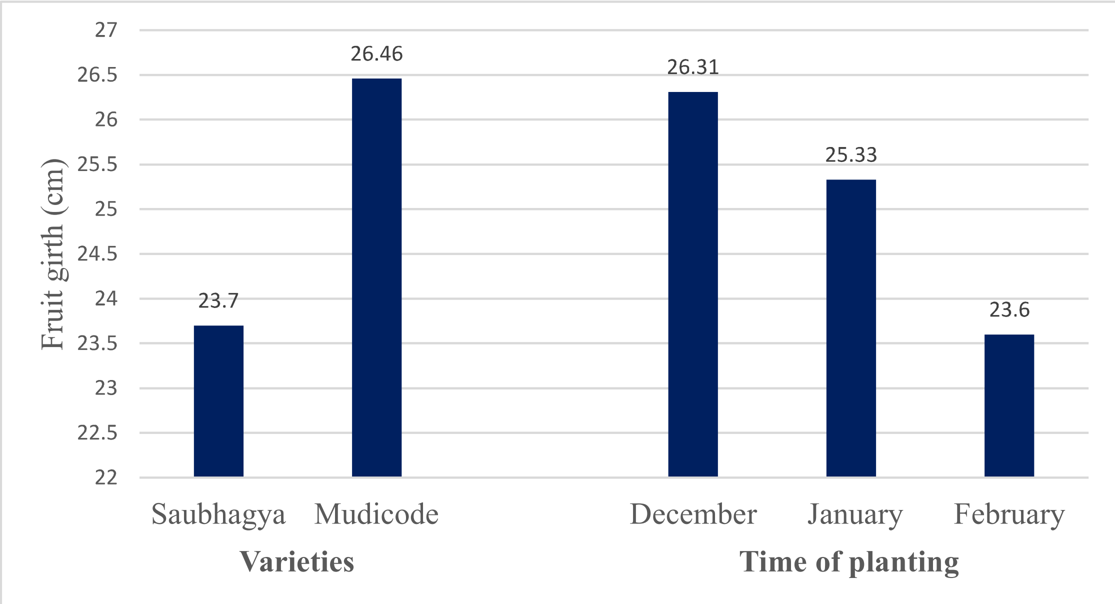


Fig 3: Fruit girth (cm) as influenced by varieties and time of planting

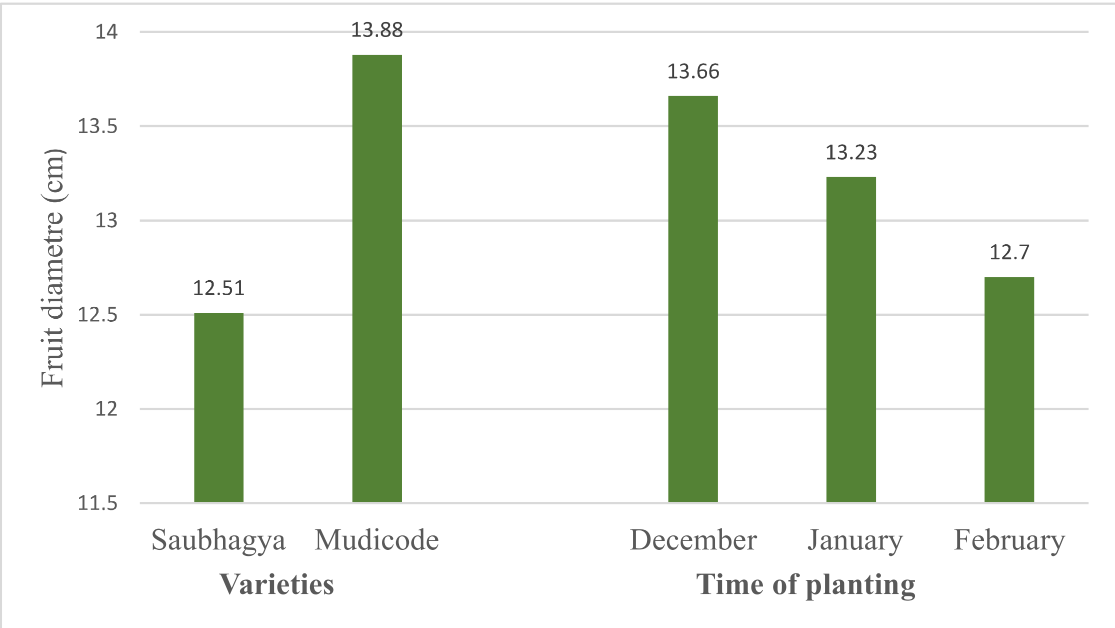


Fig 4: Fruit diameter (cm) as influenced by varieties and time of planting

5.1.3.3 Fruit diameter (cm)

Fruit diameter varied significantly among varieties and interaction between varieties and dates of planting whereas, the variation was non-significant among the time of planting. The high value of fruit diameter was noticed in Mudicode variety (13.88 cm). These findings are in line with those of Sare *et al.* (1999), Longjam and Bijaya devi (2017) and Maragal *et al.*, (2018) in cucumber, Nagendra (2017) in oriental pickling melon and Shanmukhi *et al.* (2018) in tomato confirm the influence of the climatic conditions on fruit diameter. Variation in fruit diameter may be due to genetic variation among the varieties and their ability for exploiting the enivironmental factors under field conditions (Eifediyi and Remison, 2009).

5.1.3.4 Fruit weight (g) and fruit yield per vine (kg)

Fruit weight and fruit yield per vine were significantly influenced by varieties, time of planting and their interaction. Mudicode variety recorded heavier fruit (1073.30 g) and high fruit yield per vine (1.57 kg). This increasing trend in yield can be attributed to more or less similar trend in yield attributes like size, weight and other fruit characters. The fruit yield is the ultimate manifestation of the cumulative effect of these characters. Eifediyi and Remison (2009), Hossain (2014) and Nwofia (2015) noticed, significant effect on yield and weight of fruit due to varieties. The high yield of Mudicode variety may be attributed to genetic composition and its ability to quickly adapt to the environment. This was in agreement with the findings of Staub and Bacher (2004) who opined that cucumber yield is influenced by genetic and environmental factors, and as such is variable depending upon growing season and region. Sharma *et al.* (2001) reported that traits like fruit length, average fruit weight and number of fruits per vine are controlled by additive factors and have direct positive effects on fruit yield.

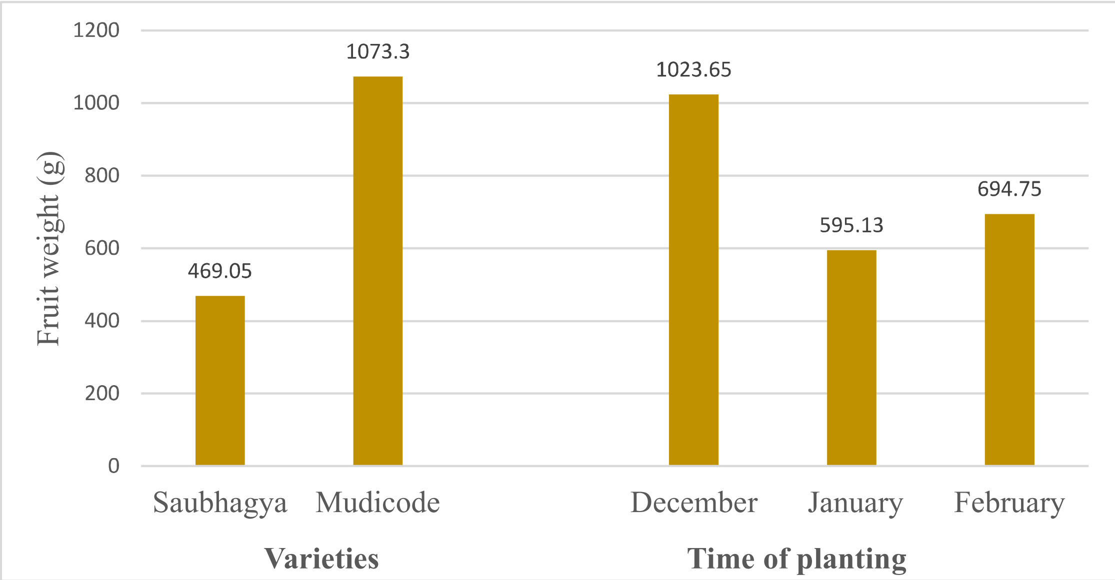


Fig 5: Fruit weight (g) as influenced by varieties and time of planting

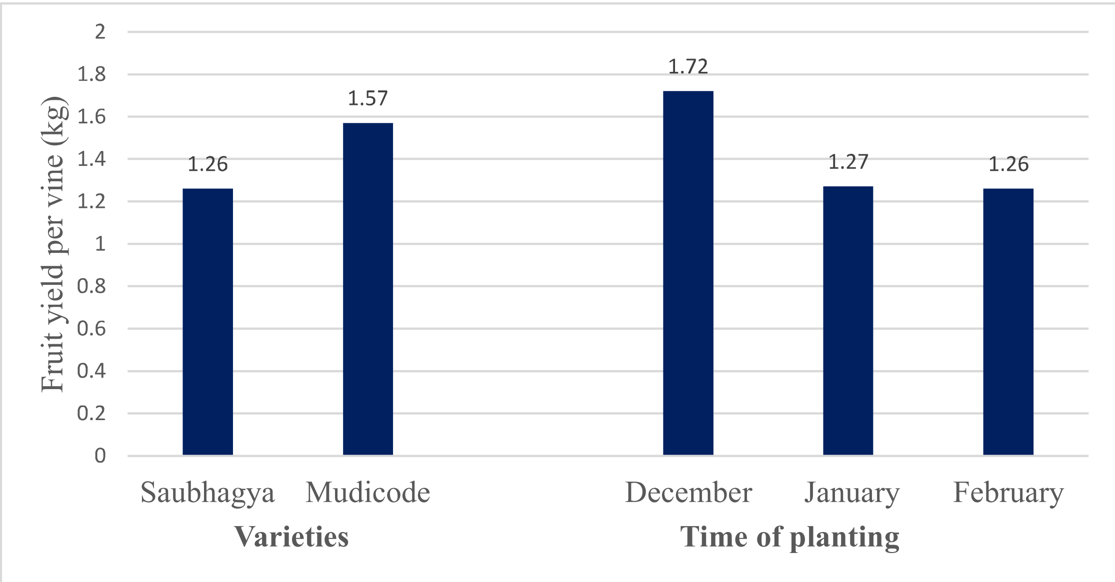


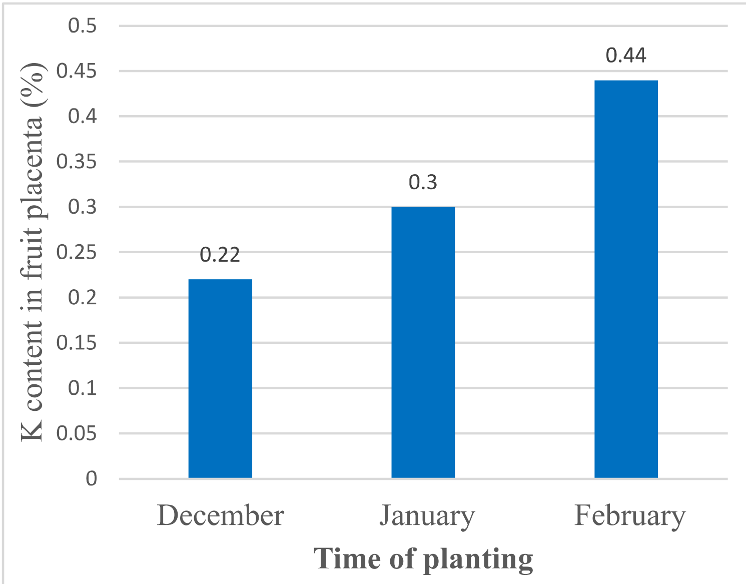
Fig 6: Fruit yield per vine (kg) as influenced by varieties and time of planting

The plants sown in December produced fruits with higher mean weight (1023.65 g) and fruit yield per vine (2.14 kg) than the later sown plants. The favourable climatic conditions, i.e. low temperature and high relative humidity prevailed during seed production time, which in turn resulted in reducing the moisture loss from fruit surface may be the reason for the larger fruit weight. The warm, humid climate that promoted vigourous growth of the vine leads to increased uptake of applied fertilizers in plants resulted in enhanced chlorophyll synthesis, carbohydrate assimilation, higher accumulation of photosynthates and distribution for developing ovules resulted in the better development of fruits. Similar variation in fruit weight and yield due to difference in planting date was reported by Dessi and Patil (1984) in melons, Neendissery (1993) in watermelon, Sare *et al.* (1999) in cucumber, Khan *et al.* (2001) in muskmelon, Murugeshan (2003) in Ash gourd, Ogbonna and Obi (2007) in egusi melon, Zaniewicz-Bajkowska *et al.* (2009) in melon, Latifi *et al.* (2012) in *Cucurbita pepo* and Divya (2013) in cabbage, Hossain (2014) in tomato, Longjam and Bijayadevi (2017), Singh *et al.* (2015) and Maragal *et al.* (2018) in cucumber, Nagendra (2017) in oriental pickling melon, Mahantesh *et al.* (2018) in Karchikai and Ranjan *et al.* (2019) in muskmelon ascribed the influence of climatic conditions on fruit weight and fruit yield per vine.

The interaction effect of varieties and time of planting on the fruit weight and yield was significant. The results on fruit yield due to interaction is in conformity with the findings by Hossain *et al.* (2014).

5.1.4 Potassium content of fruits

The potassium content of fruits is an important parameter which is related to vivipary. Melon having high potassium in fruit placenta and flesh show lower number of viviparous seeds. Potassium had vital roles in photosynthesis, favouring high energy status and appropriate nutrient translocation and water uptake in plants.



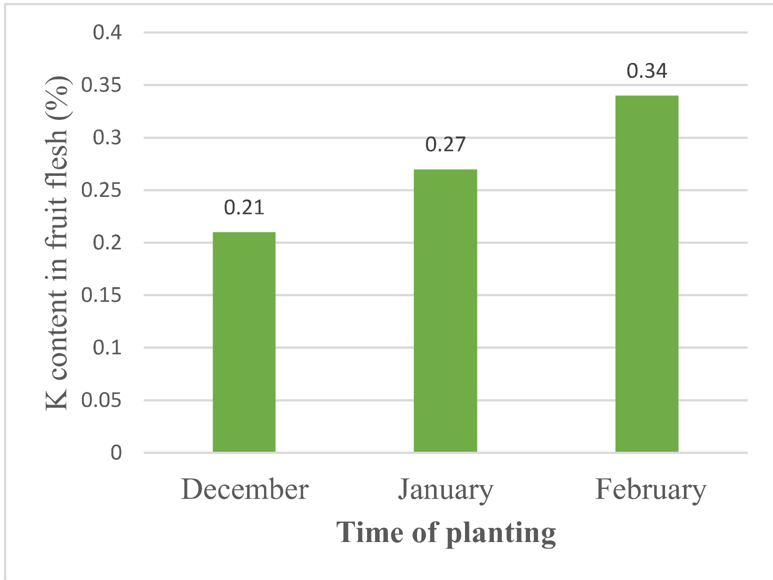


Fig 7: Potassium content in fruit placenta (%) as influenced by time of planting

Fig 8: Potassium content in fruit flesh (%) as influenced by time of planting

Potassium content in fruit flesh and placenta showed significant difference among the time of planting and varieties. Mudicode variety recorded high potassium per cent in fruit placenta (0.36%) and flesh (0.28%) while February sown crop recorded high per cent of potassium in fruit flesh (0.34%) and placenta (0.30%) compared to other sowings. The effect of planting date on the potassium content of fruit was reported by Maragal (2016) in cucumber.

The interaction effect of varieties and time of planting on potassium content of fruit flesh and placenta was also significant. The highest potassium content in fruit placenta and flesh was recorded in the variety, Mudicode planted in February.

5.1.5 Seed yield attributes

Seed yield attributes depend on the favourable climatic conditions during flowering, fruit set and harvest. Temperature play a major role among the climatic factors. The quality of seed is influenced by the stage of harvesting and is indicated by maximum dry weight, germination, and vigour of the seeds

In the present study, no significant variation was observed in the seed yield attributes like number of seeds per fruit, fresh and dry weight of the seeds, vivipary and chaffy seed per cent, 100 seed weight and seed yield with varieties.

Vivipary and chaffy seed per cent differed significantly with different planting dates but other seed attributes like seeds per fruit, fresh and dry weight of seeds, 100 seed weight and seed yield did not vary with planting dates. The reason may be that these parameters are not much affected by environmental factors. These findings are in line with Afroz *et al.* (2011) in mustard. The lowest value of vivipary and chaffy seed per cent was recorded in February planting with 1.51% viviparous seeds and 1.52% chaffy seeds. This may be attributed to high temperature, high sunshine hours and no rainfall during the flowering and fruiting stages of early sown crops. These findings are in agreement with Nagendra *et al.* (2017) in oriental pickling melon. The effect of sowing date on seed production

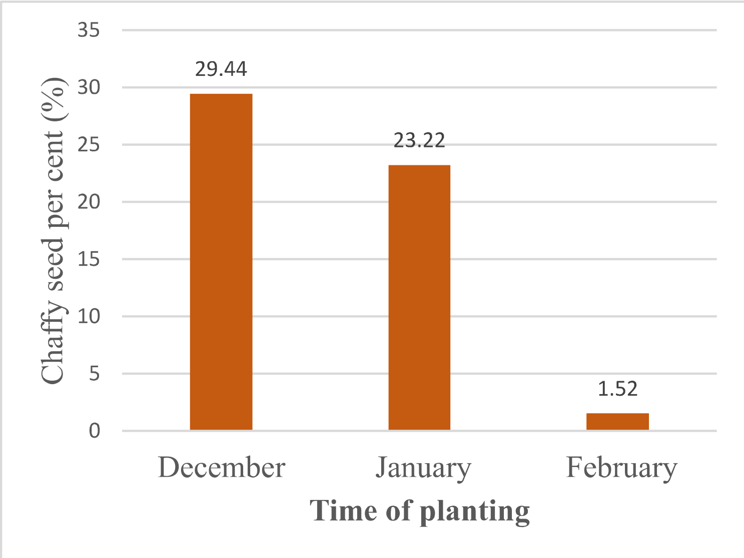


Fig 9: Chaffy seed per cent (%) as influenced by time of planting

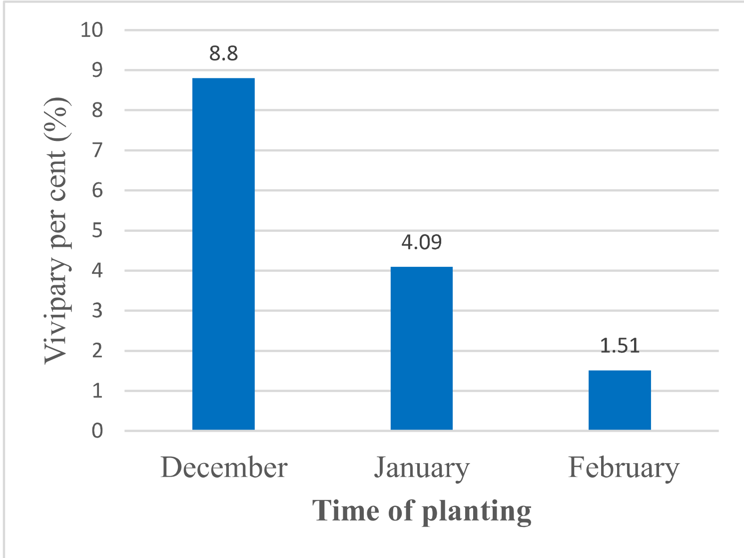


Fig 10: Vivipary per cent (%) as influenced by time of planting

was reported by Palaniswamy (1979) in okra, Incalcaterra and Iapichino (2000) in cauliflower, Neendissery (1993) in watermelon, Manikandan (2008) in grain amaranth, Latifi *et al*. (2012) in *Cucurbita pepo* and Rahman *et al*. (2014) in bitter gourd. Abak *et al*. (2000) reported the non-significant effect of different sowing dates on seed yield.

There were significant differences in vivipary and chaffy seed per cent and seed yield among different varieties over different times of planting. In contrast to the finding, seed yield was significantly influenced by planting dates in the studies conducted by Rahman *et al.* (2014) in bitter gourd, Kumar *et al.* (2015) in onion, Shahid *et al.* (2015) in okra, Singh *et al* (2015) in cucumber, Gogoi *et al*. (2016) in broccoli ,Singh *et al*. (2018) in okra and Tesfaye *et al*. (2018) in onion.

From the above results of investigation, carried during three planting dates of oriental pickling melon, it is evident that February time of sowing of Saubhagya and Mudicode is optimum for the seed production since the seed yield attributes were high and the main aspect of study i.e. vivipary occurrence was least during this month of sowing while December sowing is optimum for vegetable production among the three planting dates for both the varieties as the fruit characters were maximum.

The correlation between vivipary and weather parameters like relative humidity, rainfall, sunshine hours and wind speed was not significant however it was observed that absence of rainfall throughout the cropping period resulted in increased expression of vivipary. Throughout the December planting crop, there was no rainfall and the expression of vivipary was high. In February planting, there was rainfall and the vivipary expression was the least during this period.

5.2 Effect of nutrient levels on flowering, fruit and seed yield attributes

5.2.1 Days taken for male flower emergence (days)

Days to male flowering varied significantly among varieties whereas the variation was non-significant among nutrient levels and their interaction. Varietal

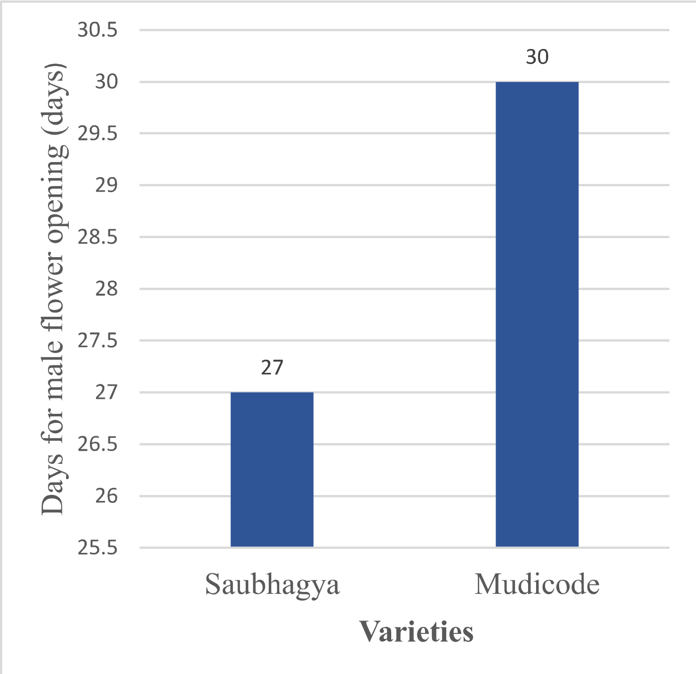


Fig 11: Days to first male flower opening (Days) as influenced by varieties

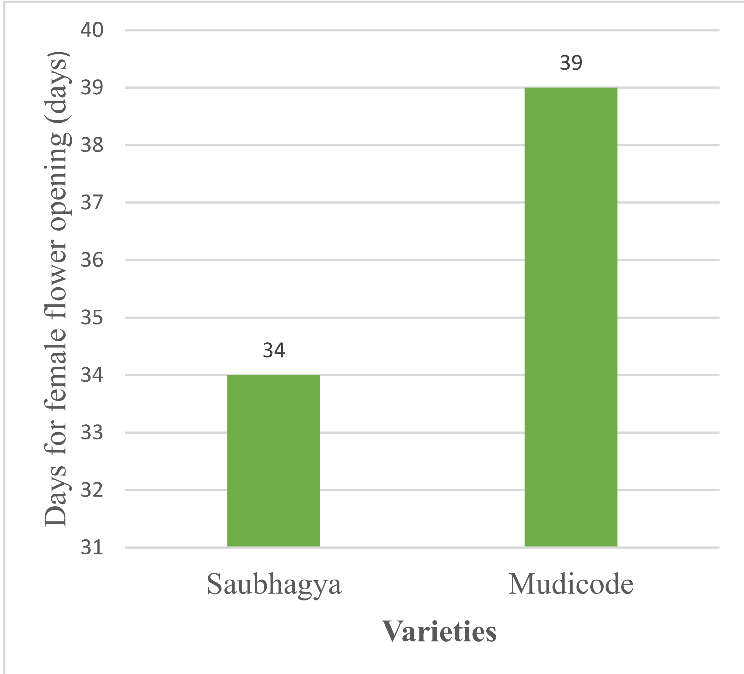


Fig 12: Days to first female flower opening (Days) as influenced by varieties

differences were noted for this parameter. Sharma *et al.* (2005) noted a significant varietal effect on days to male flower opening in cucumber. Least number of days for flowering was noted in Saubhagya variety (27 days). This may be attributed to the short duration character of Saubhagya variety.

5.2.2 Days taken for female flower emergence (days)

Days for female flower emergence were significantly influenced by different varieties and the interaction between varieties and nutrient levels. Saubhagya variety recorded the least number of days for flowering (34 days). Devi and Gopalakrishnan (2006) reported 31 days for anthesis in Saubhagya variety. Among the interaction, Saubhagya variety plants applied with nutrient levels, POP (70:25:25 NPK) + 25% K flowers early (30 days). Days to flowering did not vary with nutrient levels. These findings are in consonance with Maragal (2016) in bittegourd. They reported that fertilizer application had no significant effect on days taken to first flowering.

5.2.3 Fruit characters

Application of K fertilizer in suitable quantity increases fruit size, yields, fruit color, shipping quality, and shelf life of fruit (Kanai *et al.*, 2007).

5.2.3.1 Fruit length

Fruit length varied significantly with varieties, nutrient levels and interaction between varieties and nutrient levels. Mudicode recorded high value for fruit length (20.47 cm). Among different nutrient levels, POP + 0.5% FS recorded the highest fruit length of 23.66 cm. Foliar application of K make substantial effect on fruit length. Similar findings were reported by Jilani *et al.* (2009) in cucumber.

5.2.3.2 Fruit girth

Fruit girth varied significantly among different varieties as well as nutrient levels. The high value for fruit girth was recorded in Mudicode variety (28.62

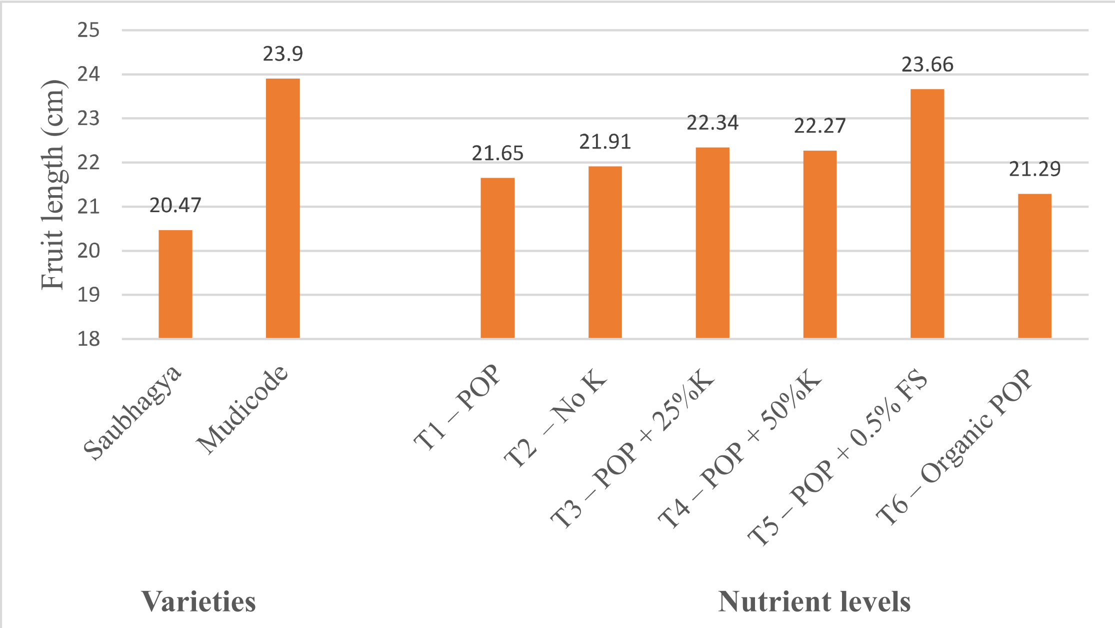


Fig 13: Fruit length (cm) as influenced by varieties and nutrient levels

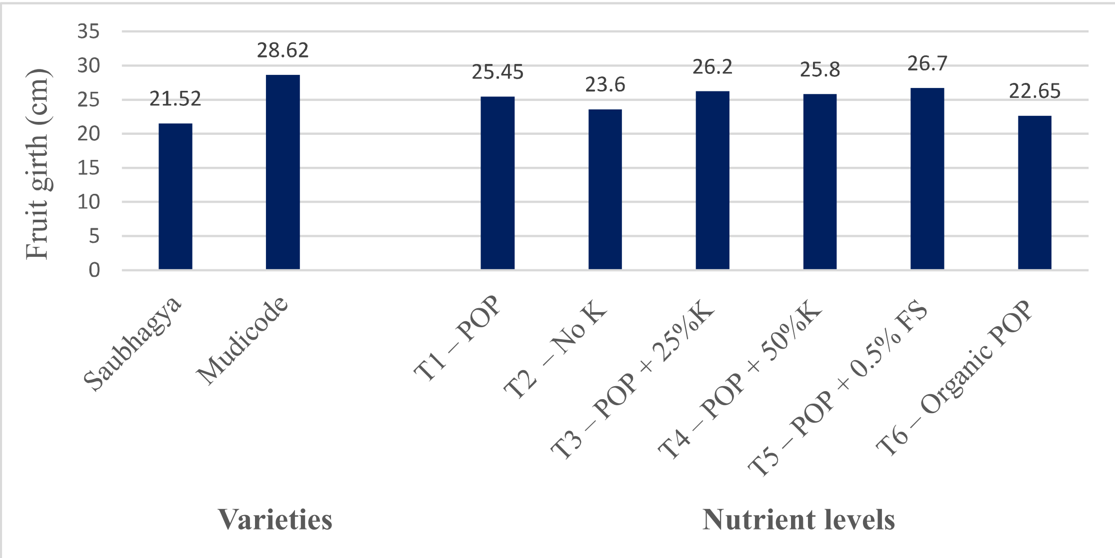


Fig 14: Fruit girth (cm) as influenced by varieties and nutrient levels

cm). Varietal difference for fruit girth in cucumber was reported by Eifediyi and Remison (2009).

Among the nutrient levels, the highest fruit girth was recorded in the treatment with POP + 0.5% FS. Fruit characters are enhanced with the additional application of K (Jilani *et al*., 2009).

There were significant differences in fruit girth with the interaction of varieties and nutrient levels. The higher fruit girth was noted in Mudicode variety under the treatments, POP + 25% K, POP + 50% K and POP + 0.5% FS.

5.2.3.3 Fruit diameter

Fruit diameter varied significantly among different varieties. Mudicode variety recorded the high value for fruit diameter (13.98 cm).

Effect of nutrient levels on fruit diameter was significant. POP + 0.5% FS (17.28 cm) and POP + 25 % K (17.10cm) recorded higher fruit diameter. The significant effect of fertilization rate of K on fruit diameter in cucumber was reported by Correa *et al*. (2018). Amjad *et al*. (2014) and Woldemariam (2018) reported that K application significantly induced fruit diameter. This could be ascribed to activation of enzymes by K and its involvement in adenosine triphosphate (ATP) production, which is important in regulating the rate of photosynthesis which enable the plants to have more food to be stored in the fruits (Havlin *et al*., 2005).

Significant differences in fruit girth are observed with the interaction of varieties and nutrient levels. The higher fruit diameter was noted in Mudicode variety under the treatments, POP + 0.5% FS, POP + 25% K and POP + 50% K.

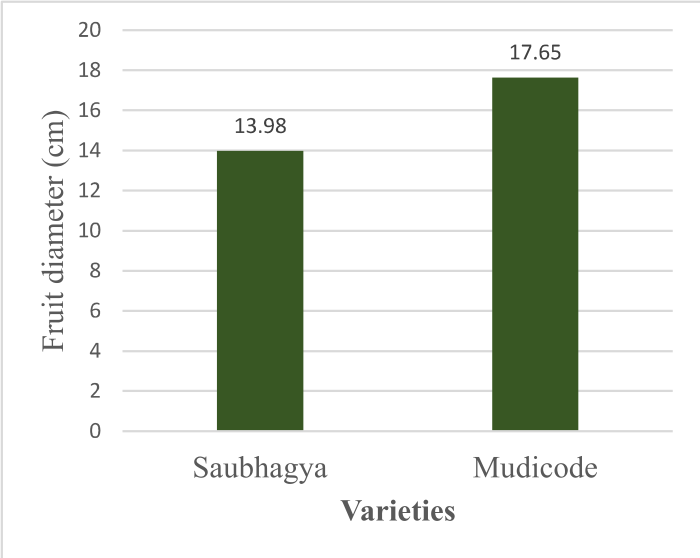


Fig 15: Fruit diameter (cm) as influenced by varieties

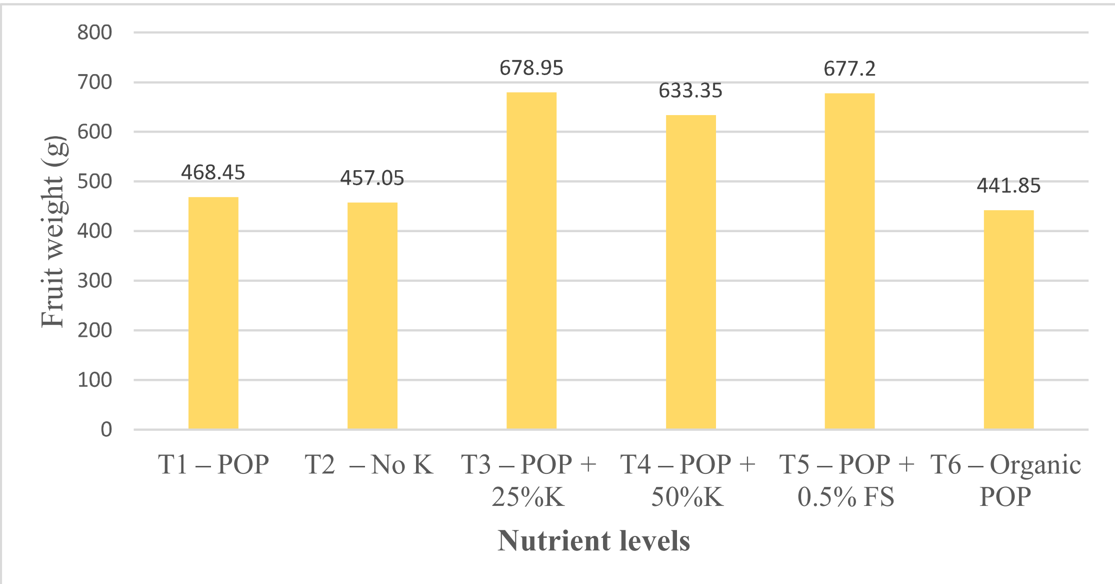


Fig 16: Fruit weight (g) as influenced by nutrient levels

5.2.3.4 Fruit weight

Variation in fruit weight was significant among different nutrient levels. Heavier fruit was noted in the treatments, POP + 25% K (678.95 g), POP + 0.5% FS (677.20 g) and POP + 50% K (633.35 g). This may be attributed to the reason that nutrient applied in these treatments are sufficient and balanced which in turn resulted in increasing fruit yield attributes. The higher dose enhanced the metabolic and physiological activity leading to increased photosynthetic rate which translocated the maximum food assimilates to reproductive parts resulting in increased fruit weight. Woldemariam (2018) noticed the significant effect of K application on fruit weight. Correspondingly Ghourab *et al*., (2000), Kacha *et al*., (2017) and Correa *et al*. (2018) stated that application of adequate K increases fruit weight by increasing translocation of photosynthates to fruit and water use efficiency. Ramadan and Sahlaby (2016) reported significant increase in fruit weight with foliar application of potassium and liquorice extract.

Interaction effect between varieties and nutrient levels on fruit weight was also significant. No significant difference was observed between varieties for fruit weight. Similar findings are reported by Eifediyi and Remison (2009) and Rehamn *et al*. (1995) in cucumber.

5.2.3.5 Fruit yield per vine

Fruit yield per vine varied significantly among varieties, different nutrient levels and the interaction between varieties and nutrient levels. Mudicode variety recorded high fruit yield per vine among the varieties.

The highest fruit yield per vine was noticed in the treatment with POP + 0.5% FS (1.41 kg). Afzal *et al*., (2015) reported that low concentrations of foliar potassium (0.6%) led to increased fruit yield. This could be due to the fact that sufficient supplement of K helps plants improve photosynthetic activities and translocation of photosynthates from sites of production to storage organs (Cakmak *et al*., 2005, El-Latif *et al*., 2011 and Patil, 2011). Potassium had a

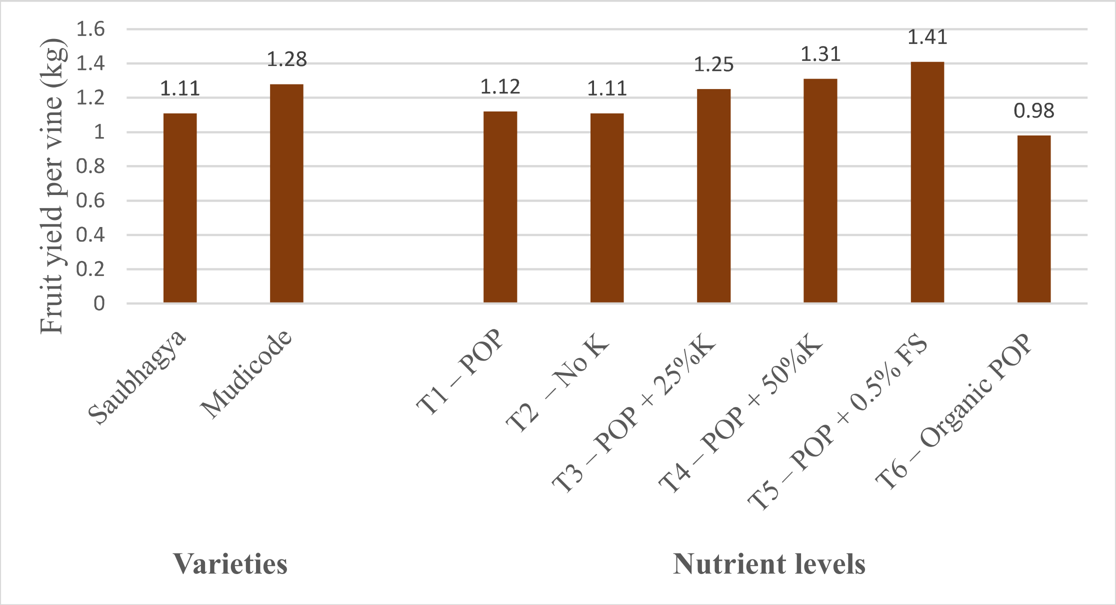


Fig 17: Fruit yield per vine (kg) as influenced by varieties and nutrient levels

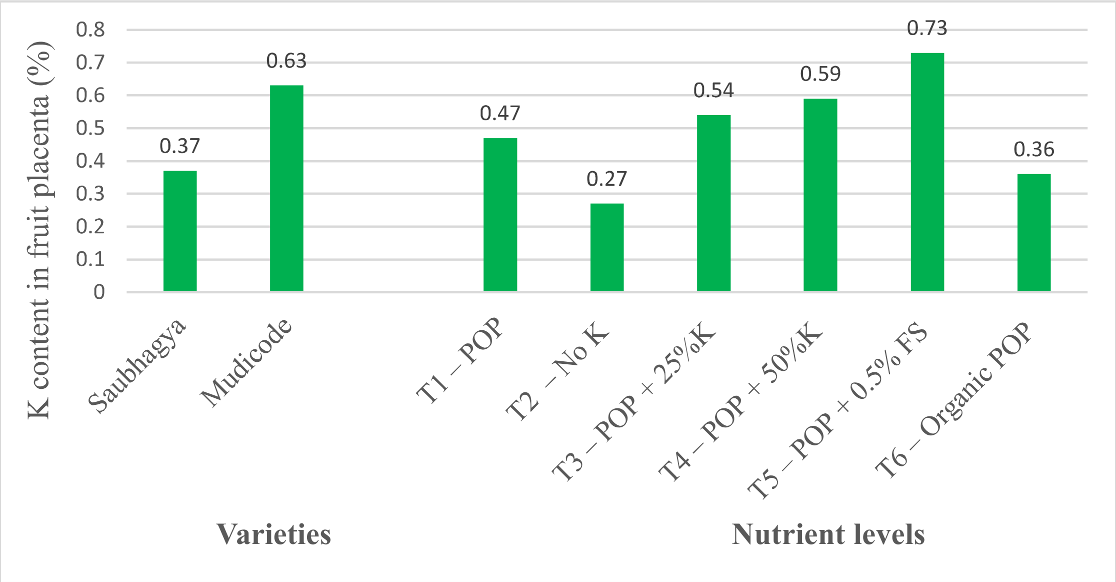


Fig 18: Potassium content in fruit placenta (%) as influenced by varieties and nutrient levels

significant effect on yield and quality parameters was observed by Woldemariam, (2018) in tomato and Botella *et al*., (2017) in pepper. Significant variation was noticed on fruit yield per vine with the interaction effect of varieties and nutrient levels. Ramadan and Sahlaby (2016) reported a significant increase in fruit yield with foliar application of potassium and liquorice extract.

5.2.4 Potassium content of fruits

Potassium (K), which is necessary for efficient plant growth and development, exists predominantly as a free or absorptive bound cation. It helps in the transport of water and nutrients through the xylem, influencing various biochemical and physiological parameters like photosynthesis, respiration, protein synthesis, cell extension, and wall thickness and stability (Abbas *et al*. 2011). It not only activates enzymes, but its involvement also in the production of adenosine triphosphate (ATP) is important in regulating the rate of photosynthesis. An adequate quantity of K plays a major role in crop growth and development by activating abundant enzymes that control cell osmoregulation and the stomatal movement during photosynthesis.

Potassium content in fruits varied significantly among varieties and between different nutrient levels. Mudicode variety recorded high potassium per cent in fruit flesh (0.42%) and placenta (0.63%).

The highest potassium per cent in fruit placenta was noticed in POP + 0.5% FS (0.73%) while potassium per cent of fruit flesh was highest in POP + 50% K (0.53%). High potassium fertilization promotes the translocation of photosynthetic assimilate to fruits resulted in the accumulation of more nutrients in fruits. The uptake of potassium by plants from foliar application of potassium chloride and additional availability of potassium through fertilizers resulted in high per cent of potassium in fruits. The result of the study also revealed that the foliar application of potassium increased the availability of potassium to plants and increased nutrient supply in rhizosphere which culminated into more absorption of nutrient

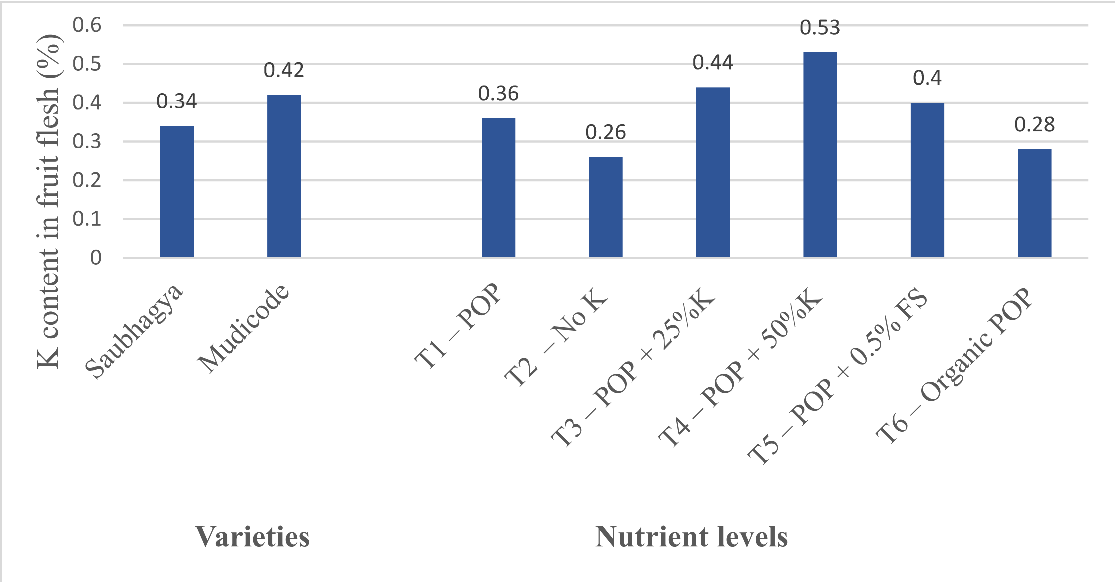


Fig 19: Potassium content in fruit flesh (%) as influenced by varieties and nutrient levels

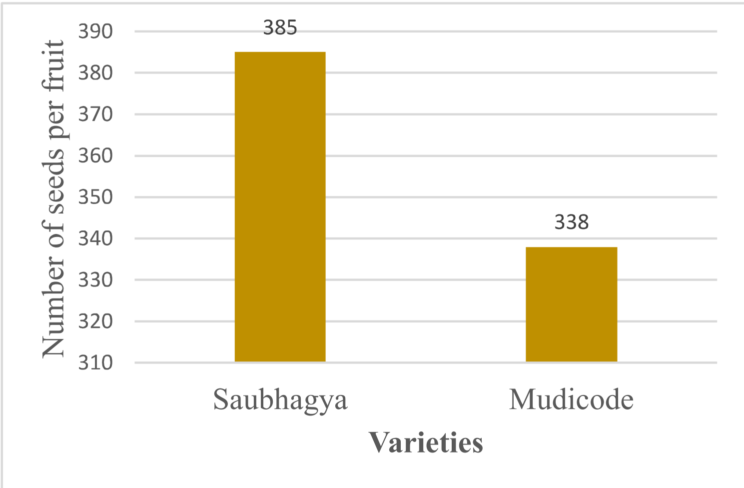


Fig 20: Number of seeds per fruit as influenced by varieties

by the crop. Lester *et al*. (2005) suggested that potassium concentration can be increased in melon fruits by supplemental foliar potassium application.

5.2.5 Seed yield attributes

Seed yield attributes includes number of seeds per fruit, fresh and dry weight of the seeds, vivipary and per cent, chaffy seed per cent, 100 seed weight and seed yield. Fresh weight of the seed is an important character that determines the quality of the seed (Abdul-Baki and Anderson, 1973) while dry weight of the developing seeds can be used to assess the maturity of the seeds.

Seed yield attributes like number of seeds per fruit, fresh and dry weight of the seeds, vivipary per cent and seed yield significantly varied with varieties.

Mudicode variety recorded high value for fresh and dry weight of the seeds while Saubhagya recorded high value for number of seeds per fruit, seed yield and least value for vivipary per cent.

Fresh and dry weight of seeds, vivipary and chaffy seed per cent differed significantly with different nutrient levels but other seed attributes like seeds per fruit, 100 seed weight and seed yield does not vary with different nutrient levels. The highest fresh weight of the seeds was noticed in POP + 50% K (8.03 g) and POP + 0.5% FS (7.69 g) which was on par with POP with no K (7.12 g), POP + 25% K (7.11 g) and POP (6.99 g). The treatment, POP + 50% K (7.77 g) recorded the highest dry weight of the seeds which was on par with the other five treatments. Similar findings of non- significant differences on the seed number per fruit and the seed weight at a high level of potassium fertilization was reported by Ochi *et al*. (2013). Amjad *et al*. (2004) reported the positive influence of potassium on seed yield and seed weight.

Lowest value for vivipary and chaffy seed per cent was recorded in the treatment, POP + 0.5% FS with 1.42 per cent viviparous seeds and 1.54 per cent chaffy seeds which was on par with POP + 50 % K. Ochi and Ito (2012), Ochi *et*

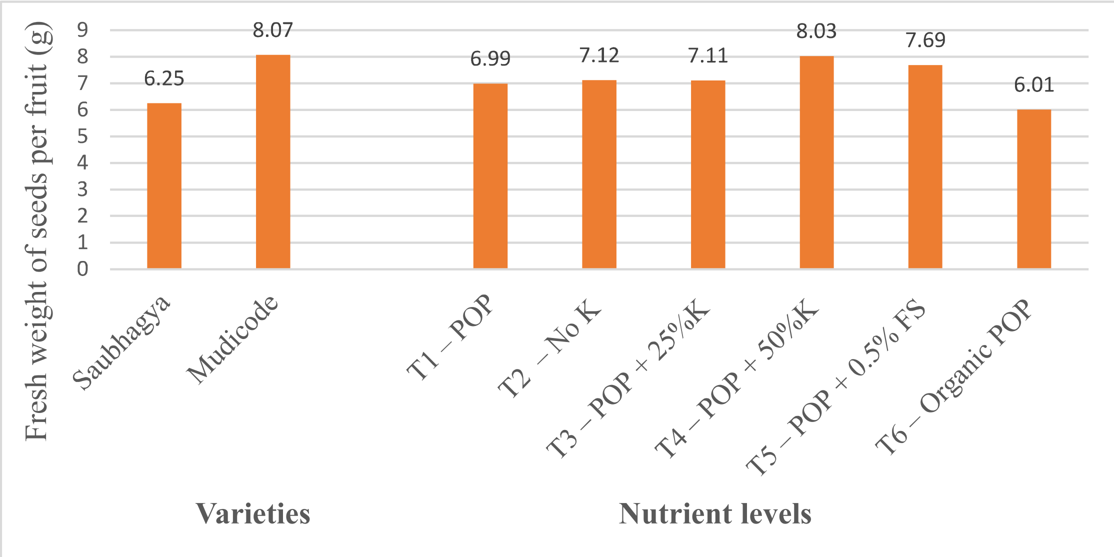


Fig 21: Fresh weight of seeds (g) as influenced by varieties and nutrient levels

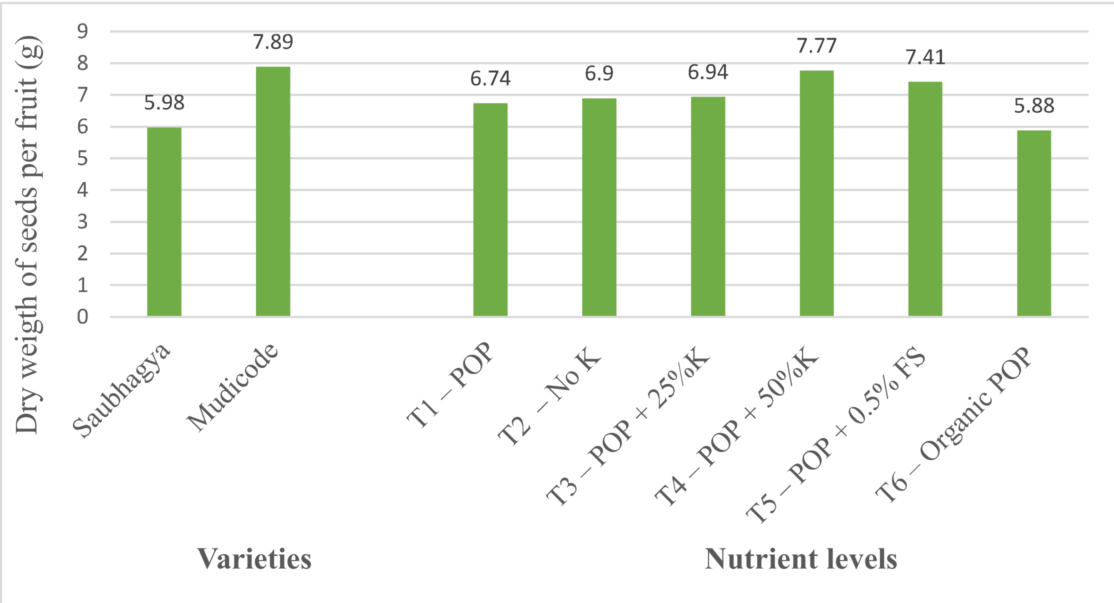


Fig 22: Dry weight of seeds (g) as influenced by varieties and nutrient levels

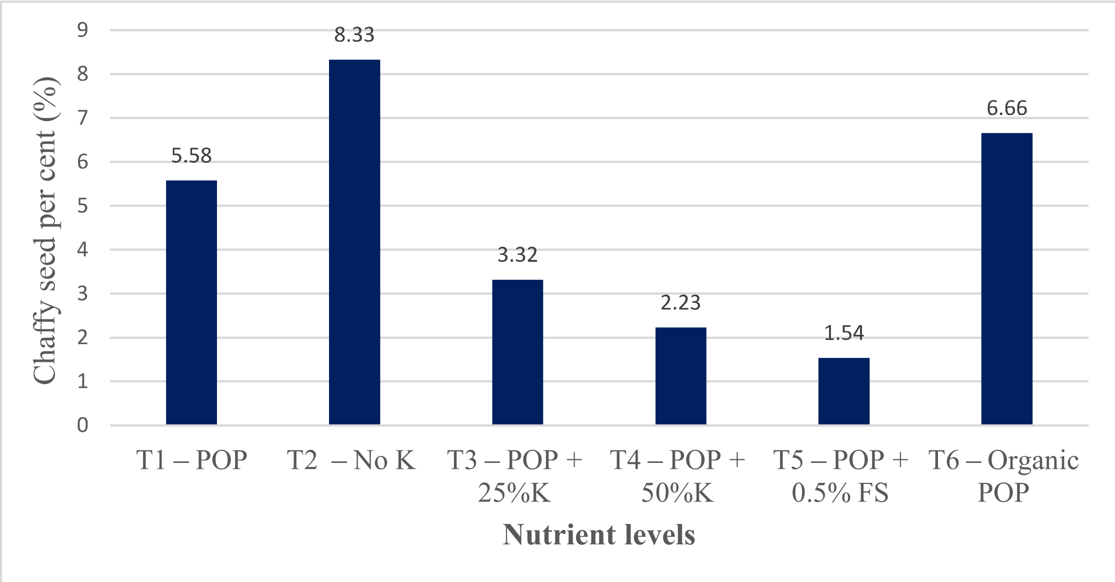


Fig 23: Chaffy seed per cent (%) as influenced by nutrient levels

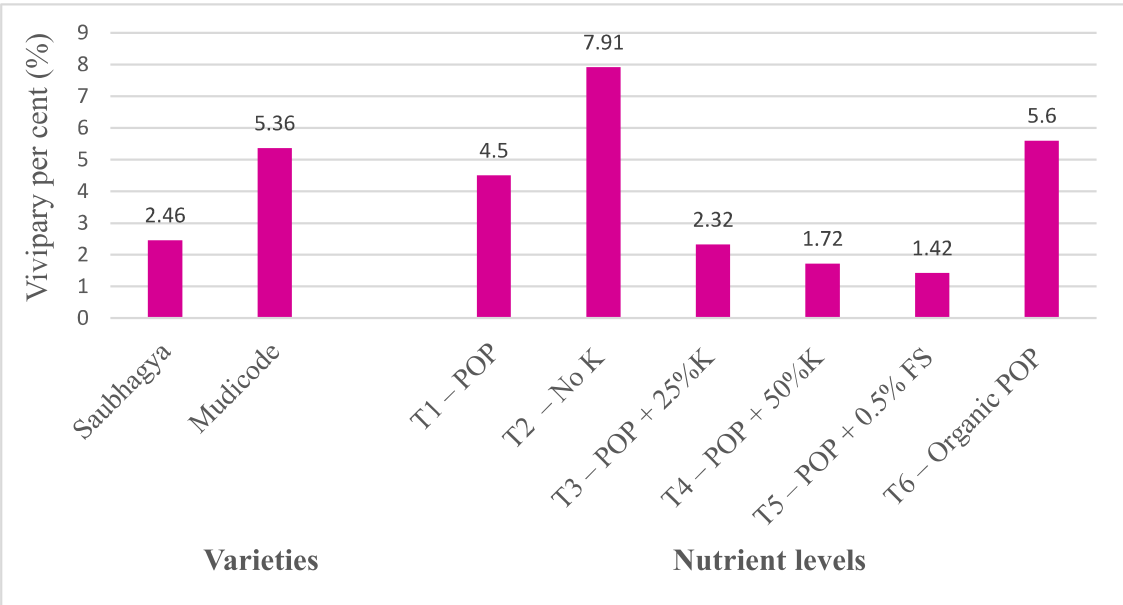


Fig 24: Vivipary per cent (%) as influenced by varieties and nutrient levels

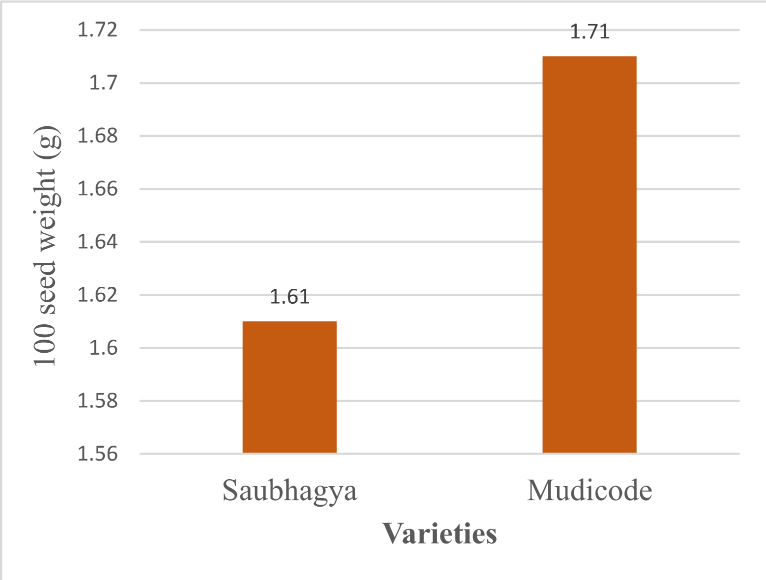


Fig 25: 100 seed weight (g) as influenced by varieties

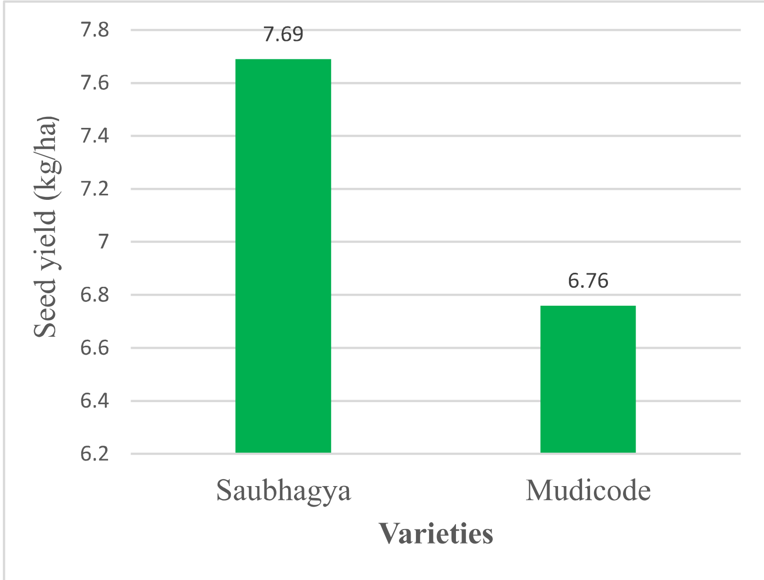


Fig 26: Seed yield (kg/ha) as influenced by varieties

al. (2013) reported marked decrease of viviparous sprouting with high potassium fertilization level in melon fruits.

There were significant differences in seeds per fruit, fresh and dry weight of seeds, vivipary and chaffy seed per cent and seed yield among different varieties over different time of planting.

It is concluded that application of K fertilizer has significant and positive influence on seed yield and fruit quality parameters of oriental pickling melon. The treatments with additional potassium application i.e., POP + 25% K, POP + 50% K, and POP + FS recorded high fruit and seed yield parameters. Saubhagya variety exhibited high seeds per fruit, seed yield and low percentage of viviparous seeds while variety Mudicode exhibited high fruit yield attributes, fresh and dry weight of seeds and 100 seed weight among the varieties.

5.3 Effect of storage on seed quality and longevity

Seeds collected from the fruits were collected and stored in sealed 700 gauge polythene bags at ambient temperature for a period of six months to study the effect of storage on seed quality and longevity.

Regardless of the varieties and treatments given during the crop growth, the seed quality parameters like germination per cent, seedling length, seedling dry weight and vigour index I and II progressively declines as the storage period increases. This was in consonance with that of Manjunath *et al*. (2008) in chilli stored for 12 months, Alhamdan *et al.* (2011) in cucumber, onion, carrot and tomato seeds, Navya (2016) and Sandhya (2016) in chilli, Shobha (2016) and Athmaja *et al.* (2018) in ash gourd, Nagendra *et al*. (2017) and Reshma (2018) in oriental pickling melon, Reshma (2018) in okra.

The marked decrease in the seed quality parameters under advancing storage period may be attributed to seed coat characters, age induced physicochemical seed deterioration, lipid peroxidation leading to production of toxic metabolites that act upon cell and cell organelles, denaturation of proteins and enzymes (Roberts, 1972).

Results of the study indicated that initially, the germination per cent was high in Saubhagya (97.67%) and Mudicode (96.83%). Later germination per cent decreased with increase in storage period. Among the treatments, T_4 (POP + 50% K), T_5 (POP + 0.5% FS) and T_3 (POP + 25% K) exhibited superior germination throughout the storage period. Even at the end of six months, germination above 90.00 per cent was retained for both varieties under different nutrient levels. The advantage of application of different nutrient management practices during crop growth on subsequent germination of harvested seeds as observed in the study was in agreement with that of Jeffers *et al*. (1982), Hasanuzzaman *et al*. (2018) and Hunje (2019).

Seedling growth is considered to be an important tool that can be used for assessing the magnitude of deterioration. Seedling length comprises of the seedling shoot length and root length. Mudicode variety recorded the highest seedling shoot length while Saubhagya variety was found to have high seedling root length during each month of storage among the varieties which indicates varietal differences for this character. Gradual decline was observed with the advancement of storage period (Kandil *et al*., 2013) which results in reduction of seed vigour due to seed aging process. Studies concluded by Aswathi (2015) in cowpea and Hunje *et al.* (2019) in soyabean indicated similar results to the present study.

The decrease in length of seedlings could be due to ageing or deterioration of seed, which is a progressive process, accompanied by accumulation of metabolites and which progressively decreases germination and growth of seedlings with increased age and ultimately vigour of seed during storage. (Hunje *et al*., 2019).

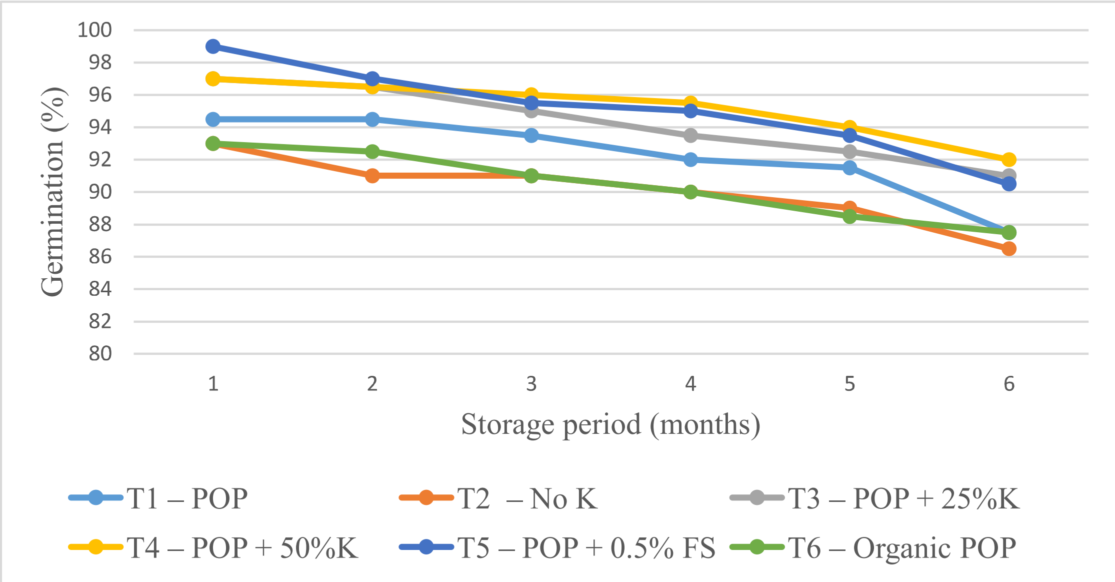


Fig 27: Germination per cent (%) as influenced by nutrient levels

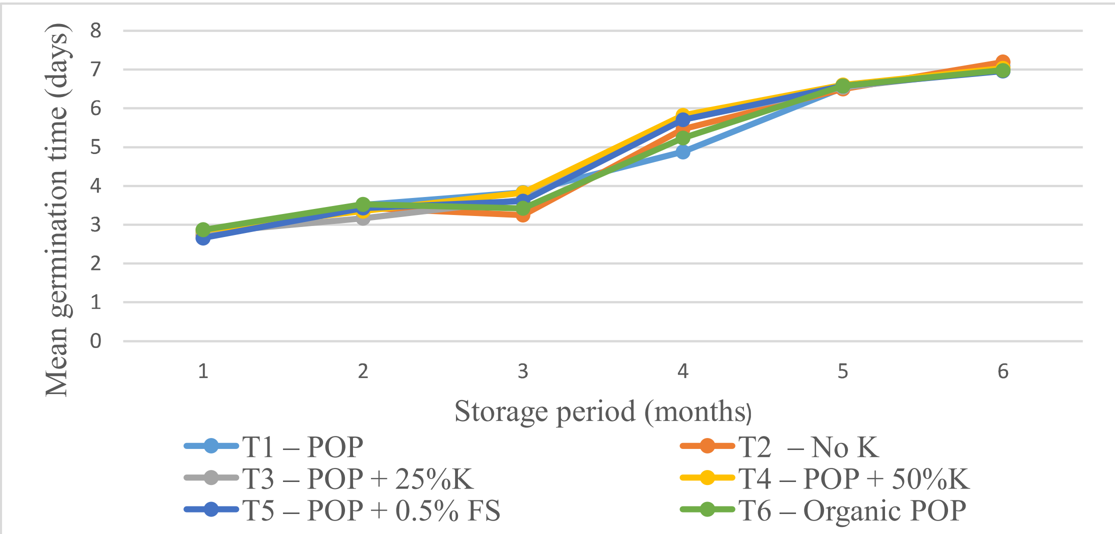


Fig 28: Mean germination time (Days) as influenced by nutrient levels

Seedling length was found to differ significantly with nutrient management practices during the crop growth in both varieties. Seeds collected from T_5 (POP + 0.5% FS) followed by T_3 (POP + 25% K), T_4 (POP + 50% K) and T_6 (organic POP) were found to be superior over all other treatments for shoot length whereas, T_6 (organic POP) followed by T_5 (POP + 0.5% FS), T_2 (POP without K) and T_4 (POP + 50% K) were found to be superior from all other treatments for root length during storage. Concurrent results related to the effect of different nutrient levels on the seedling length of harvested seeds were reported by Razaq (2017) and Hunje *et al.*(2019).

The dry weight of the seedlings is an important factor to determine the vigour index. Among the varieties, Saubhagya variety (0.020 g) recorded high values and was significantly superior over seedlings of Mudicode (0.016 g). In the present study, it was observed that seedling dry weight declined with increase in storage period. This is in consonance with Naguib *et al.* (2011) and Kandil *et al.* (2013).

Seed vigour is "the sum total of those properties of the seed which determine the level of activity and performance of the seed or seed lot during germination and seedling emergence" (ISTA, 2001) and also an indicator of the storage potential of a seed lot. According to Abdul Baki and Anderson (1973), vigour index was determined as vigour index – I and II, where vigour index- I is a function of seedling length (shoot length + root length) and germination per cent, while vigour index –II (Bewley and Black, 1994) is a function of seedling dry weight and germination per cent. The vigour index of the seeds was initially high irrespective of varieties and treatments given during crop growth thereafter it decreased and lowest vigour index was recorded at six month of storage. Mudicode variety recorded high value for vigour index- I while vigour index- II was high for Saubhagya variety. So it is clear from the study that differences exist among varieties with regard to seed longevity. Simlar results of drastic decrease in vigour index as compared to intial vigour index at the end of storage period was reported by Mangena and Mokwaala (2019) in soyabean.

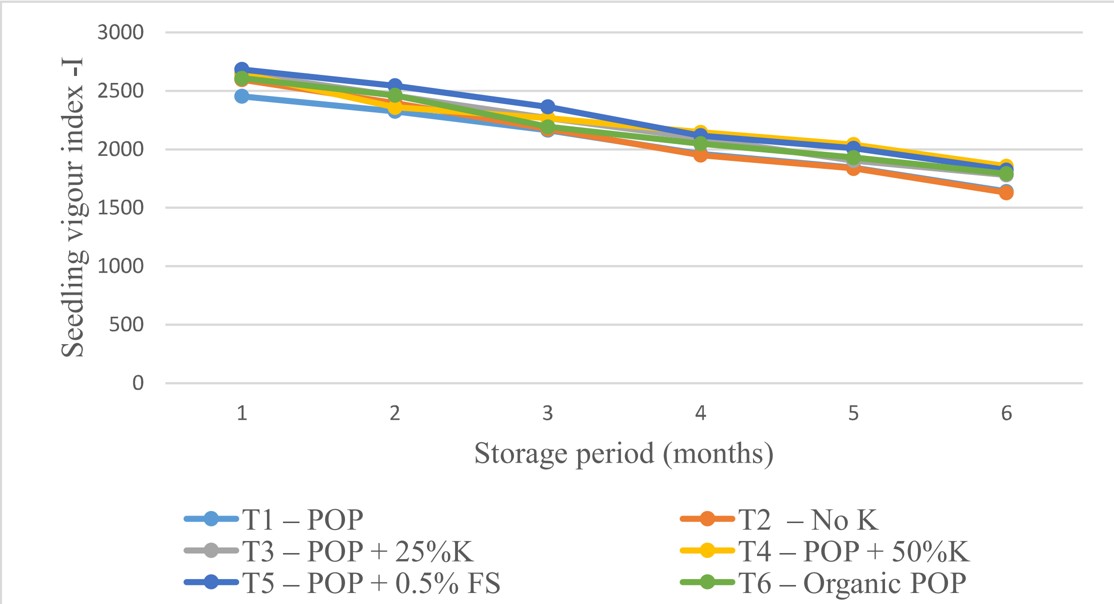


Fig 29: Seedling vigour index -I as influenced by nutrient levels

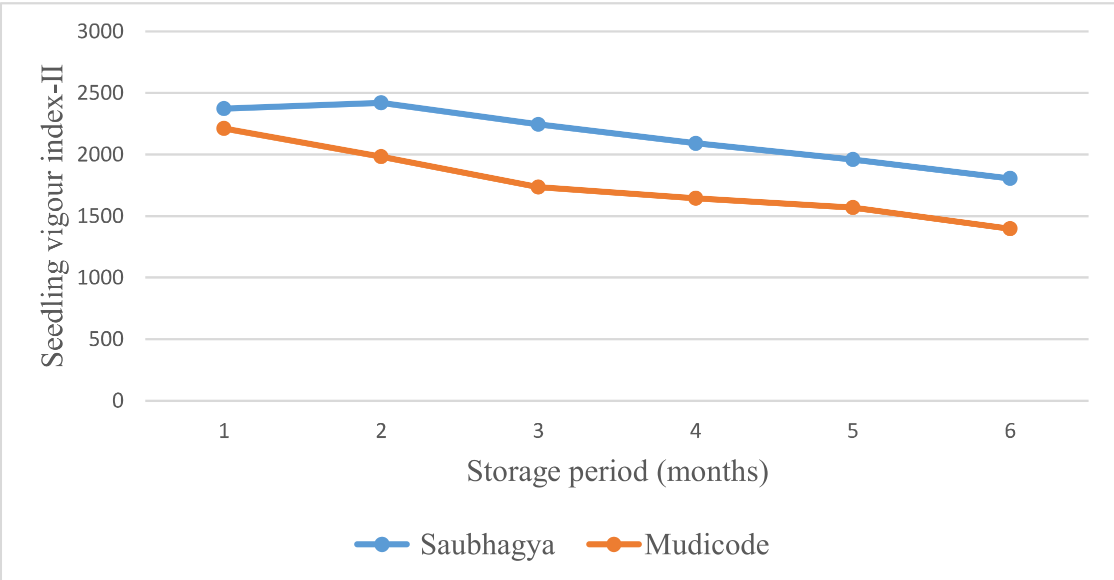


Fig 30: Seedling vigour index -II as influenced by varieties

The rate of decline in seed vigour is conditioned by several factors, including genetic constitution of the species, condition of the seed, storage condition, and uniformity of seed lot. Loss of vigour can be thought as an intermediate stage in the life of the seed, occurring between the onset and termination of death. Laxman (2017) have opined that seed vigour and viability declined during storage.

Seeds collected from T_5 (POP + 0.5% FS) followed by T_4 (POP + 50% K), T_3 (POP + 25% K) and T_6 (organic POP), were found to be superior over all other treatments at the end of storage for vigour index- I while no significant variations were observed for vigour index- II with respect to nutrient levels.

Electrical conductivity (EC) of seed leachate is an indication of the viability and vigour of the seed. Loss of membrane integrity of deteriorated seeds leaks more substances into the medium. This could be attributed to the high mechanical injury, poor membrane structure and leaky cells. This results in greater loss of electrolytes such as sugars, amino and organic acids from seeds and increased conductivity in the soaked water. Thus, low conductivity means a high-quality seed and vice versa. Less vigourous or more deteriorated seeds show lower speed of cell membrane repair during seed water uptake for germination and therefore release greater amounts of solutes to the external environment (Marcos-Filho, 2015). It also appears to be a deciding factor for seed renewal time during storage period in retailer point of view and can be used as a routine test in checking for viability of seeds (Demir *et al.*, 2016).

In the present study, value of EC increased with increase in storage period among the varieties. Similar findings are reported by Naguib *et al.* (2011), Navya (2016) and Sandhaya in chilli, Shobha (2016) and Athmaja *et al.* (2018) in ash gourd and Nagendra *et al.* (2017) in oriental pickling melon. The low levels of EC showed that there is lower leakage representing a slower loss of solutes from the undamaged cells or healthy tissues of the seeds, suggesting that the Mudicode variety seeds collected from T_2 (POP + 0.5% FS) followed by T_3 (POP + 25% K)

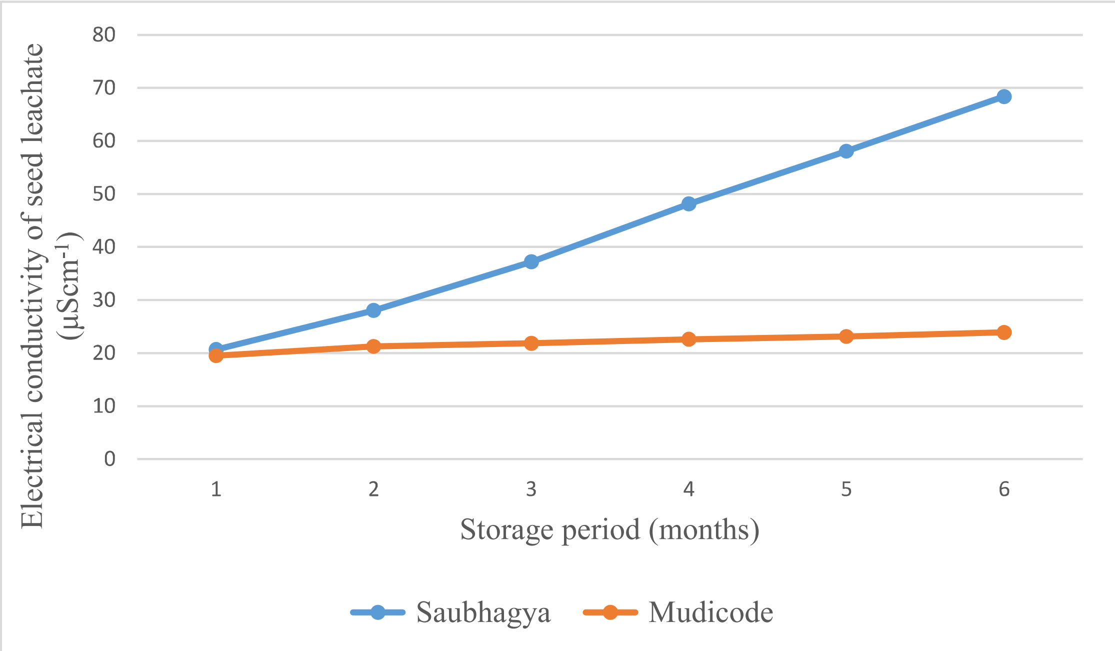


Fig 31: Electrical conductivity of seed leachate (µScm^{-1}) as influenced by varieties

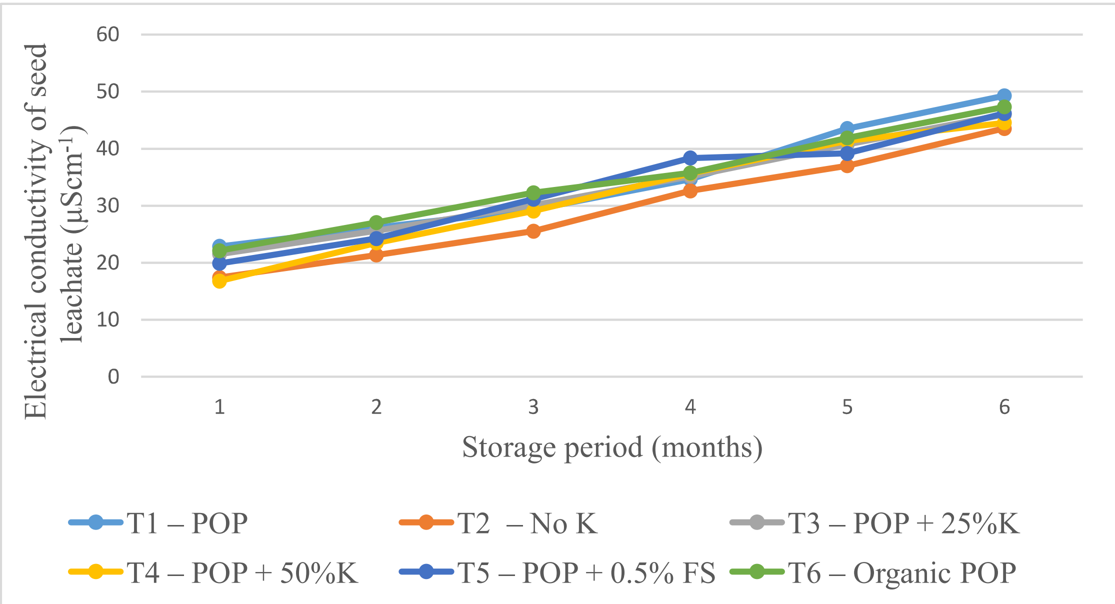


Fig 32: Electrical conductivity of seed leachate (µScm^{-1}) as influenced by nutrient levels

was more suitable than other treatments. At the end of storage period, electrical conductivity of seed leachate was 68.38 μScm^{-1} and 23.90 μScm^{-1} in Saubhagya and Mudicode respectively. Electrical conductivity values were significantly varying with nutrient treatments given during crop growth. Similar findings were quoted by Basavaraj *et al*. (2008) in onion at the end of six months of storage; Manjunath *et al*. (2008) in chilli stored for 12 months.

Mean germination time is an important aspect of vigour and provides reasonably good index of vigour of any seed lot. It is way to calculate germination speed (Zhang *et al.,* 2014). MGT was calculated from the formula cited by Ellis and Roberts (1980). It is calculated as the weighted mean of the germination time (hour, day or other time unit). The number of germinated seeds at the intervals established for the data collection is used as weight (Ranal and Santana, 2006). MGT is an accurate measure of the time taken for a lot to germinate, but does not correlate this well with the time spread or uniformity of germination. It focusses instead on the day when most germination events occurred. The lower the MGT, the faster a population of seeds has germinated.

Results indicated that mean germination time tends to increase with increase in storage period. The low values of MGT show higher germination per cent and good vigour of seeds. Mudicode variety (2.57 days) recorded the least value of MGT. Irrespective of nutrient levels, mean germination time progressively increased with storage period. Seeds collected from T_5 (POP + 0.5% FS) followed by T_6 (organic POP) and T_3 (POP + 25% K) recorded the least value for mean germination time and was found to be superior over all other treatments at the end of storage.

The number of days required to reach 50% seed germination can be used as an index of seed vigour. Time taken for 50% germination is considered inversely proportional to seedling vigour which is determined by the time taken to reach 50% of final/maximum germination with argument method specified as "coolbear", is computed according to the formula by Coolbear *et al*. (1984) and modified by Farooq *et al*. (2006).

The earliness in time taken for 50% germination reflect quick germination and higher vigour. This germination parameter also follows the same trend with storage period as that of mean germination time. Mudicode variety recorded the least number of days to attain 50% germination among the varieties. It was initially low for both varieties and increased towards sixth month of storage. The effect of nutrient levels on time taken for 50% germination was found to be non-significant over the storage.

Seed moisture content was similar in both varieties and was not significantly influenced by nutrient levels. Mean seed moisture was 6.20%. The advantage of storing seeds in moisture impervious polythene bags over cloth or jute bags for maintaining seed viability and prolonging seed viability has been reported by several workers in various crops (Patel *et al*., 2017; Saisanthosh and Patil, 2018 and Bakhtavar *et al*., 2019).

Seeds harbour a great variety of micro flora, especially fungi. Roberts (1972) reported that the viability and vigour of the stored seeds is mainly reduced due to storage fungi. No seed infection was recorded during the start of storage. Significant variations were recorded for seeds harvested from the different nutrient treatments. The seed infection varied from 1.00 per cent to 7.00 per cent. The lowest seed infection was observed for the seeds treated with POP + 25% K (1.00%) and organic POP (1.00%) during crop growth. Nam *et al*. (2006) suggested that a minimum of nitrogen and potassium should be present in any fertilizer used for decreasing any disease severity. The seed infection increased with increase in storage period. Christensen (1972) reported that fungi not only cause qualitative and quantitative loss of seed, but also increased the moisture content of the seeds in storage, bring biochemical changes leading to decreased membrane integrity, decrease food reserves in seed and cause rapid death of seeds within a short period of time. Jeffers *et al*. (1982) found that K fertilization almost always decreased seed pathogen levels and occasionally increased seed germination. Where germination was increased by K fertilization, the incidence of pathogen nearly always remained unchanged. Thus, K fertilization usually does not influence infection of seed, but possibly limits fungal growth after infection has occurred. They also reported that K fertilization decreased *Phomopsis* sp. 23 per cent points in lower seeds in contrast to 14 per cent points in upper seeds of soyabean

Future line of work

1. The present study confirms the occurrence of vivipary during summer season in Oriental pickling melon as the study was restricted to summer season. Presence of vivipary if any in monsoon period may also be investigated as a future line of work.
2. The effect of potassium application through foliar spray on growth, seed and fruit yield and vivipary may be investigated in detail as foliar spray was found to decrease the occurrence of vivipary.
3. Seed longevity studies were done for six months only in the present study and hence may be extended till the loss of viability under both ambient and refrigerated condition to get a realistic picture of the effect of potassium nutrition on seed quality and longevity.

Summary

6. SUMMARY

The emphasis on quality seed production has become more relevant in the present scenario since the direct contribution of quality seed alone to the total production is about 15 – 20%. Vivipary is a major problem in the seed industry, as it drastically affects seed quality. Keeping this in view, an experiment was conducted at the Department of Seed Science and Technology, College of Horticulture, Vellanikkara, Kerala Agricultural University (KAU), Thrissur on 'Potassium nutrition on vivipary and seed quality in oriental pickling melon (*Cucumis melo* var. *conomon* Mak.)' during the year 2017 – 2019.

The soil of the experimental field was sandy clay loam. The field experiment was laid out in factorial randomized block design (FRBD), where the effect of time of planting on vivipary on two varieties was assessed with three different time of planting i.e., December, January and February with four replications and the effect of potassium on vivipary, was observed following six treatments (T_1: Control: POP (70:25:25), T_2: No K (70:25:0), T_3: 70:25:37.5 (25 % additional K), T_4: 70:25:50 (50 % additional K), T_5: POP + foliar spray, T_6: Organic POP) and three replications. Further the seeds are collected and the seed quality during storage was effectuated following a factorial completely randomized design with three replications.

The study was carried out in Saubhagya and Mudicode varieties of oriental pickling melon. The salient findings and conclusions drawn out of the investigation are summarized here below.

1. **Effect of time of planting on vivipary**

    1. Variety Mudicode recorded higher values for parameters like fruit length, girth, diameter, weight and fruit yield per vine. Female flower emergence was early in Saubhagya.
    2. Significant differences were noticed for traits like days to male and female flower opening, fruit weight , fruit yield per vine, K content in

fruit flesh and placenta, chaffy seed per cent and vivipary per cent for the different times of planting (December, January and February).

3. December planting is advantageous for fruit yield since the days taken for female flower opening was less and the fruit parameters were higher.
4. February planting can be followed for seed production as the occurrence of viviparous and chaffy seeds were minimum in this crop.
5. Fruit length, girth and diameter was significantly superior in Mudicode variety planted in December whereas the vivipary per cent and chaffy seed per cent were the least in Saubhagya, planted during February.
6. Seeds per fruit and seed yield were recorded higher for variety Mudicode, in December, January and February planting and Saubhagya variety in February planting.

2. Effect of potassium levels on vivipary

1. Days to first male and female flower opening, fruit length, girth, diameter and fruit yield per vine, K content in fruit flesh and placenta, seeds per fruit, weight of the seeds, 100 seed weight, seed yield and vivipary per cent differed among the two varieties, Saubhagya and Mudicode.
2. Variety Saubhagya showed higher number of seeds per fruit and the occurrence of vivipary per cent was also low in variety Saubhagya.
3. Larger fruits and high fruit and seed yield were observed for variety Mudicode. K content in fruit flesh and placenta were also higher in this variety compared to Saubhagya.
4. Potassium levels significantly influenced the fruit length, girth, diameter, weight and fruit yield per vine, K content of fruit placenta and flesh, fresh and dry weight of seeds and vivipary per cent.
5. NPK test as per POP (70:25:25) + 0.5% foliar spray of MOP recorded the highest values for fruit length, girth, diameter and fruit yield per vine and K content in fruit flesh and placenta whereas the nutrient management practices like POP + 25% K, POP + 0.5% foliar spray and

POP + 50% K recorded higher fruit weight and least number of viviparous seeds.

6. The treatment with POP (70:25:25) + 0.5% foliar spray of MOP recorded the lowest number of chaffy seeds.
7. Saubhagya flowered earlier than Mudicode while, Mudicode variety with additional potassium application exhibited the higher values for fruit length, girth, diameter weight and K content in fruit placenta and flesh.

3. Seed storage studies

1. The seed quality and longevity of varieties differ during the storage period.
2. Germination per cent, seedling shoot and root length, seedling dry weight, seedling vigour index I and II declined progressively over the storage period while electrical conductivity of seed leachate, mean germination time, time taken for 50% germination were observed to increase with an increase in the storage period.
3. Seeds collected from treatments, T_4 (POP (70:25:25) + 50% K), T_5 (POP (70:25:25) + 0.5% foliar spray) and T_3 (POP (70:25:25) + 25% K) exhibited high germination per cent, seedling shoot length, seedling dry weight and vigour index I and II as compared to other treatments throughout storage.
4. Germination percentage of 60 per cent was retained even for six months in both varieties irrespective of fertilizer levels.

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POTASSIUM NUTRITION ON VIVIPARY AND SEED QUALITY IN ORIENTAL PICKLING MELON (*Cucumis melo* var. *conomon* Mak.)

By

ATHULYA S KUMAR

ABSTRACT OF THE THESIS

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ABSTRACT

Oriental pickling melon (*Cucumis melo* var. *conomon* Mak.) is an important vegetable crop cultivated in Kerala. This short duration crop has the potential to produce high yields with low input requirements, so often referred as unique vegetable of Kerala. Quality seed production in melon is affected due to the occurrence of vivipary.

A study in oriental pickling melon varieties, Saubhagya and Mudicode was conducted in the Department of Seed Science and Technology, College of Horticulture, Vellanikkara, Thrissur, during 2017-2019 to elucidate the effect of potassium nutrition on vivipary and seed quality. The objective of the study was to assess the effect of time of planting and potassium application on vivipary and their effect on seed quality.

The effect of time of planting on vivipary was assessed with three different time of planting *i.e.,* December, January and February following a factorial randomized design with four replications. The fruit and seed yield attributes were found to be significantly influenced by varieties, time of planting and their interaction. Variety Mudicode was superior in parameters like fruit weight, fruit yield and female flower emergence was early in the crop sown in December. However, the presence of viviparous seeds and chaffy seed percentage were observed to be high in December planted crop. The potassium content in fruit flesh and placenta was found to be highest in the crop sown during February with minimum percentage of viviparous and chaffy seeds. The results point out that December planting is advantageous for fruit yield while February planting is advantageous for seed production in variety Mudicode. The interaction between varieties and time of planting on seed quality indices pointed out that it is advantageous to go for February time of planting for variety Mudicode for seed production.

In order to study the effect of potassium on vivipary a crop was raised in February 2018 following a factorial randomised design with six treatments and three replications. During the experiment, fruit and seed quality parameters were found to be significantly influenced by varieties, fertilizer levels and their

interaction. Variety Mudicode exhibited high fruit yield attributes, fresh and dry weight of seeds and 100 seed weight whereas seeds per fruit, seed yield was superior in Saubhagya with low percentage of viviparous seeds. Irrespective of varieties, treatments with additional potassium application *i.e.,* POP + 25% K, POP + 50% K, and POP + foliar spray recorded high fruit and seed yield. Organic nutrient management also resulted in seed yield of 7.48 kg ha^{-1}. High potassium content in fruit placenta and fruit flesh was found in treatments which exhibit least percentage of viviparous and chaffy seeds i.e., POP + foliar spray and POP + 50% K. Additional potassium application was found to be advantageous for reducing the occurrence of viviparous seeds by increasing the K content in fruit placenta and flesh. The interaction between varieties and fertilizer levels on fruit and seed parameters pointed out that additional potassium nutrition was advantageous for fruit and seed yield production of Mudicode whereas fruit weight, seeds per fruit, seed yield and occurrence of viviparous seeds and chaffy seed percentage was the least among the treatment combination of variety Saubhagya with POP + foliar spray.

The seed quality during storage was evaluated following a factorial completely randomized design with the seeds collected from Experiment-II (six treatments and two replications). The seeds were dried to less than 8 per cent moisture and packed in polyethylene covers of 700G and stored under ambient conditions for a period of six months. The seed quality parameters were recorded at monthly intervals. The seed moisture and seed micro flora per cent were recorded at the start and end of the storage. Seed longevity was found to be significantly vary between varieties, fertilizer levels, and their interaction throughout the storage period. Germination, vigour indices I and II, decreased progressively over the storage period. However, towards the end of storage period, there was an increase in mean time to germination, time taken for 50 per cent germination, electrical conductivity of seed leachate, seed micro flora per cent. Irrespective of the varieties, fertilizer levels and their interaction, germination percentage of 60 per cent was retained even after six months. The study revealed that that the seeds can be stored for 6 months under the ambient conditions.