PRODUCTION TECHNOLOGY FOR ORGANIC WATERMELON

SHEEBA, B.S.

(2009-11-140)

Department of Agronomy

COLLEGE OF AGRICULTURE

VELLAYANI, THIRUVANANTHAPURAM – 695522

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THESIS

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2011

DECLARATION

I hereby declare that this thesis entitled **"Production technology for organic watermelon"** is a bonafied record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award of any degree, diploma, associateship, fellowship or other similar title, of any other university or society.

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CERTIFICATE

Certified that this thesis entitled **“Production technology for organic watermelon”** is a record of research work done independently by Sheeba B.S (2009-11-140) under my guidance and supervision and that it has not previously formed the basis for the award of any degree, diploma, and associateship to her.

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Sheeba, B.S.

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LIST OF ABBREVIATIONS

@	**-**	**at the rate of**
^{o}C	**-**	**Degree celsius**
%	**-**	**Percent**
CD	**-**	**Critical difference**
Cm	**-**	**Centimetre**
DAS	**-**	**Days after Sowing**
et al.	**-**	**And others**
Fig.	**-**	**Figure**
FYM	**-**	**Farmyard manure**
ha	**-**	**Hectare**
ha^{-1}	**-**	**Per hectare**
g	**-**	**Gram**
i.e.	**-**	**That is**
K	**-**	**Potassium**
K_2O	**-**	**Potash**
Kg	**-**	**Kilogram**
kg ha^{-1}	**-**	**Kilogram per hectare**
mg	**-**	**Milligram**
N	**-**	**Nitrogen**
No.	**-**	**Number**
NS	**-**	**Not significant**
P	**-**	**Phosphorus**
P_2O_5	**-**	**Phosphate**
Plant $^{-1}$	**-**	**Per plant**
POP	**-**	**Package of practice**
Rs	**-**	**Rupees**
SE	**-**	**Standard error**
t ha^{-1}	**-**	**Tonnes per hectare**
Viz.	**-**	**Namely**

Introduction

1. INTRODUCTION

Cucurbits were among the first group of plants used by man. They include dessert salad, pickling and culinary types. Among the dessert type, watermelon is the most important crop in the tropical regions of the world. Watermelon (*Citrullus lanatus*) is an important cucurbitaceous vegetable. It is known as tarbuj, tarmuj, kalinda and kalindi in different parts of India. An excellent desert fruit, it is relished by rich as well as poor. The fruit juice makes an excellent refreshing and cooling beverage. The fruit contain 92% water, 0.2% protein, 0.3% minerals, and 7% carbohydrate in 100 g edible flesh. Watermelon is not only a refreshing fruit to beat the heat on a hot summer day but it has a few health advantages. Water melon is also very effective in reducing body temperature and blood pressure. This fruit may also help in reducing inflammation that contributes to conditions like asthma, atherosclerosis, diabetes, colon cancer, and arthritis. Watermelon is full of water, carbohydrates and fibre along with essential vitamins and minerals that provides nutrition to the body for better metabolism. Watermelon is a rich source of citrulline, an amino acid that can be metabolized to arginine, an essential amino acid.

Majority of water melons reach Kerala from neighbouring states, but now it is grown in a limited area in the Malabar region. It has got great scope to be cultivated in the entire state. Studies conducted at KAU proved the feasibility of watermelon cultivation in the state and identified certain varieties and hybrids (AICVIP 1994). From a varietal trial, Shibukumar (1995) found Sugar Baby as the promising variety under Vellayani condition.

Maximum productivity can be obtained by cultivating watermelon under optimum weather conditions. Watermelon requires hot dry climate and a long growing season preferably with warmer days and cooler night. It cannot withstand frost or very low temperature. For seed germination, an optimum moisture and a soil temperature between 25-30^{0}C is needed. Similarly plant growth is optimum under 28-30^{0}C, while fruiting is better at 24-27^{0}C. Higher temperature is beneficial during ripening. Considerable alteration in yield and quality has been found due to different date of planting. Hence time of planting play a major role in determining the productivity and quality of watermelon.

In order to obtain high yield of water melon, there is need to augment the nutrient status of the soil to meet the crop's need and thereby maintaining the fertility of the soil. One of the ways of increasing the nutrient status is by boosting the soil nutrient content either with the use of organic materials such as poultry manure, animal waste, and use of compost or with the use of inorganic fertilizers (Dauda *et al.*, 2005). The importance of organic manure as the source of nutrition became popular during the last few decades on account of the excessive use of chemical fertilizers which resulted environmental hazards. FYM is a cheap and effective source of nitrogen for sustainable crop production, but its availability remains an important issue due to its bulky nature, while inorganic fertilizer is no longer within the reach of poor-resource farmers due to its high cost. According to Beckman (1973) the manure application enhances soil productivity, increases the soil organic carbon content, soil micro-organisms, improves soil crumb structure, the nutrient status of the soil and enhances crop yield.

Hence the present investigation is aimed to find out a suitable date of planting and the effect of different doses of FYM on the growth, yield and economics of organic water melon cultivation.

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Review of Literature

2. REVIEW OF LITERATURE

Watermelon is an important cucurbitaceous vegetable in the tropical regions of the world. Maximum productivity can be obtained by cultivating vegetables under optimum weather conditions. Time of planting play a major role in determining the productivity and quality of watermelon. Application of organic materials enhances the nutrient status of soil and crop yield. Maximum yield is possible only through providing a suitable combination of these factors. Information on suitable date of planting and the effect of different doses of FYM on the growth, yield and economics of organic water melon cultivation is limited. The available literature on vegetables pertaining to the present study is reviewed here.

2.1 Effect of date of planting on growth characters of vegetables

Surlekov and Ivanov (1969) from an experiment on cucumber using cultivars, Starozagorski, Langi and Donski-175 sown on 20th and 30th April and 10th and 30th May, concluded that the April planting produced plants of the greatest length and the largest number of laterals.

Heij (1981) observed that when cucumber cultivar Farbio was planted at weekly or fortnightly intervals between 13th December and 14th January with different day/night temperature, stem elongation increased with rise in temperature.

Khan et al., (2001) in an experiment with tinda gourd (*Citrullus vulgaris var fistulosus*) to determine the best date of sowing from 20th February to 19th April observed that early seed sowing speed up germination days and maximum vine length.

In a study conducted by Sharma et al., (2005) on cucumber cultivars with different dates of sowing from 15th December to August at two months intervals, it was observed that plant stand was on par at February and December sowing and February sowing was statistically higher than later sowings. The poor plant stand at latter sowings might be associated with the higher temperature and the heavy moisture conditions of soil and air, which lead to the spread of root and shoot diseases. The December, February and April sowings had statistically no difference in number of nodes plant^{-1} where as June sowing had the highest number of nodes. The extensive growth of vine in June sowing was due to warm and humid weather condition favorable for vegetative growth. The December and February sowings were found appropriate for proper growth of the vines. The effect of sowing dates on the branch number plant^{-1} was similar to that of node number plant^{-1}. There was no statistical difference on number of branches plant^{-1} on earlier sowing dates.

In a study conducted by Oloyede and Adebooye (2005) to determine the effect of season on growth and fruit yield of snake tomato (*Trichosanthes cucumerina*.L) during the early season (April-July) of 2002 and late season (August-November) of 2003 reported that the early season crop had significantly higher number of leaves and vine length compared to the late season crop.

Ogbonna and Obi (2007) in a study to identify the effects of time of planting on the growth and yield of Egusi melon (*Colocynthis citrullus* L.) reported that early planting on April 2nd depressed early plant development like vine length and number of branches due to low rainfall at early season. They also reported that at later planting dates (May 14th and 28th), both vine length and number of branches plant^{-1} were significantly low due to high rainfall and humidity which impeded the growth and development of this crop.

A study conducted by Zulu (2010) to determine the effect of planting date on growth and yield of wild water melon during three different dates (25th September 2008, 23rd November 2008 and 20th January 2009) it was observed that September planting resulted in 45 % more vine length than in November and January planting.

2.2 Effect of date of planting on yield characters of vegetables

In a study on cultivation of cucurbits, Whitaker and Davis (1962) observed that later planting dates were not suitable for fruit set due to low temperature.

Surlekov and Ivanov (1969) reported that April sowing and planting dates produced plants with the largest number of fruits, highest mean fruit weight and the greatest seed number and weight.

Kartalov (1970) from his trial to establish appropriate dates for sowing and planting cucumber cultivars found that the highest yield was obtained with the earliest sowing and planting dates viz., 17^{th} January and 22^{nd} February respectively.

Using earlier and later planting dates in cantaloupe production redacted cantaloupe productivity due to the high or louse temperatures (Sedgely and Buttrose 1978). Nandpuri and Lal (1978) in a two year trial with eight muskmelon cultivars found that the March planted crop took significantly fewer days to ripen than the November planted crop.

Kmiecik and Lisiewska (1981) from a three year trial observed highest average yield of commercial and processing cucumbers for earlier dates of sowing viz., early or late May or early June. Heij (1981) reported that both increase in temperature and delay in planting promoted earliness of fruit production in cucumber.

Heij and Lint (1982) working with cucumber seedlings planted in the green house on 13^{th} or 27^{th} December or 10^{th} or 24^{th} January and grown at 21-27^{0}C day temperature and 12,16 or 20^{0}C night temperature found that the later planting produced more fruits than early planting.

Khristov (1983) reported that in melons, the highest total yield was produced by April 10th planting (25.36 tones ha^{-1}) or by direct sowing on 1st April (23.63tones ha^{-1}). Delayed sowing or planting reduced yield.

Desai and Patil (1984) in a study with five dates of sowing between 10th November to 15th December on watermelon cv. Sugar baby observed that good plant growth, good fruit quality and highest yield were obtained from the plants sown on 21st November.

When melon cv. *Macrophomina phaseolina* was planted at three different times in spring, it was concluded that high yield was given by middle spring sowing (Bruton et al., 1985).

Studies conducted at Kerala Agricultural University to determine the influence of date of planting on seed yield and quality of tomato revealed that inflorescent $plant^{-1}$ (22.46), flowers $cluster^{-1}$ (5.71%), fruits $cluster^{-1}$ (4.23) and fruit set (70.07%) were maximum in October planting and it was followed by November planting and February planted crop was the worst. KAU (1987).

Delayed planting in muskmelon significantly decreased fruit weight and total fruit yield (Muhammad et al., 1989). More et al., (1990) reported that maximum numbers of pistillate flowers in cucumber varieties were obtained when sowing was done on 22nd October.

Farooq (1992) reported that the plant sown in the second week of March gave maximum fruit volume, fruit weight, number of fruits $vine^{-1}$, and yield $hactare^{-1}$ where as minimum duration for flowering and fruit maturity were recorded in late sowing of muskmelon seeds. He also stated that earlier sowing will require maximum number of days for fruit setting in muskmelon.

Studies conducted at Kerala Agricultural University to determine the influence of date of planting on the growth and yield of watermelon reported that the plants sown in second fortnight of November gave significantly higher yield (37.85 t ha^{-1}) compared to other sowing in which the yield ranged from 30.20 to 34.72 t ha^{-1}. KAU (1993).

Barker and Allen (1993) in a study on contrasting response of crop species to CO_2 and temperature observed that temperature elevation from 25 to 35°C increased the male flowers in water melon while at 40°C very few flowers were produced and they concluded that decline or increase in yield are the result of crop produced at different transplanting dates.

Studies conducted at Kerala Agricultural University revealed that October was found to be the best time of sowing bitter gourd with respect to production of female flowers and fruit yield KAU (1997).

Burki (1996) observed that the early sowing of seeds of tinda speed up the germination days, flowering, fruit setting and maturity of the fruit. This study also revealed that early sowing of tinda seeds give better yield performance and quality of fruit than late sowing.

An experiment conducted by Damato et al., (1998) on the effect of sowing date on the yield of bottle gourd (*Lagenaria siceraria*) found that the number of marketable fruits $plant^{-1}$ and marketable yield was both reduced by 66% when sowing date were delayed from May to June.

The research carried out by Saglam et al., (1999) to determine the effect of 3 sowing dates (1^{st} July, 15^{th} July and 1^{st} August) on yield of snake cucumber (*Cucumis melo var. flexuosus Naud.*) reported that highest yield was obtained from July 1^{st} sowing. They also observed that the average fruit weight, number of fruits $plant^{-1}$ and fruit diameter were increased by earlier sowing dates.

An experiment on tindagourd conducted by Khan et al., (2001) to determine the best date of sowing for obtaining high yield on six dates of sowing viz., 28th February, 10th March, 20th March, 30th March, 9th April and 19th April revealed that early seed sowing speed up the germination days, flowering, fruit setting, maturity of first fruit and the yield. They also reported that March is the best date of the sowing.

An experiment conducted by Joshi et al., (2004), to determine the effect of sowing date on yield of off-season bitter gourd during 16th September, 1st, 15th, 29th October and 12th and 26th November found that the flowering phenomenon was highly influenced by date of sowing. Both the male and female flowers appeared earliest on the plants sown in the first date of sowing i.e. 16th September while the maximum delay in flowering occurred in 29th October sowing. The first three dates showed significantly much earliness in flowering compared to the last three dates. The delayed flowering in late sowing may be due to slow germination and vegetative growth at lower temperature prevailing from November onwards. The 15th October sowing exhibited the lowest nodal position of first male as well as female flowers having mean values 8.79 and 10.52 respectively. The yield was found maximum in the earlier dates of sowing and decline in yield with each delay in sowing. The highest yield recorded in the first sowing date. The first date of sowing i.e. 16th September exhibited earlier flowering (39.3 days) and fruiting (62.9days).

According to Oloyede et al., (2005) in snake gourd, the early season (April-July) crop had significantly higher number of marketable fruits and fruit yield compared to the late season (August-November) crop. They also found that the late season crop recorded significantly higher number of aborted flowers and cull fruits. Crop yield during the early season was 22.2 tons ha^{-1} while during the late season was only 13.3 tons ha^{-1}.

An experiment conducted by Sharma et al., (2005) to determine the optimum date of sowing for commercial cultivation of cucumber, during December 1999 to November 2000 reported that yield attributing characters such as first male and first female flowers bearing nodes, number of female flowers plot^{-1}, and number of harvests were insignificantly different in December and February sowings. However, the periods of phenophases such as sowing to the first male and first female flowers and sowing to first harvest and last harvest were significantly longer at December sowing followed by those at February sowing. February sowing produced the highest number of marketable fruits and marketable yield than the earlier December and three latter sowings. The December sowing also produced significantly higher marketable yield than June and August sowings.

A study carried out by Ogbonna et al., (2007) to identify the effects of time of planting on the growth and yield of Egusi melon on five planting dates, viz. April 2, 16 and 30 and May 14 and 28 observed that the fruit and seed yield were increased as planting was done early in the season. Seed yield ha^{-1} decreased by 350% and 1117% as planting was delayed from April 2 to April 16 and to April 30, respectively. They also found that seed yield increased by 2.4% and decreased by 23.2% as planting was delayed from March 5 to March 19 and to April 2 respectively.

Refai et al., (2008) conducted an experiment for studying the effect of five planting dates i.e., June 15th, July 1st, July 15th, August 1st and August 15th on growth and yield of cantaloupe (*Cucumis melo var. cantaloupensis*) found out that there were highly significant differences among the five planting dates while, the planting date on July 15th was the best than the other planting dates for characters like number of days to first female flower anthesis, total yield and fruit length.

A field experiment conducted by Eifediyi and Remison (2009) on the effect of time of planting on the growth and yield of cucumber *(Cucumis sativus L.)* observed that the mean yield of cucumber for the three months of April, May and June 2006 were significantly different. They also observed that planting in April produced the highest yield, and the June planting, the lowest. They also observed that the high yield experienced during the April planting over the May and June plantings were due to moderate rainfall at the flowering and fruiting stage of the crop which began in the middle of May.

In a study conducted by Zulu (2010) to determine the effect of planting dates on growth and yield of wild watermelon during three different dates (25th September 2008, 23rd November 2008 and 20th January 2009) found that the highest number of fruits was obtained from September and this was 32% greater than the fruits from November, and 64% more than the January planting. They also found that September planting is associated with a significantly higher number of large fruits compared with the other planting dates and majority of fruits were small. From September to November there was a 32% decline in fruit size and it went down by 50% when planting was delayed to January. Crop yield decreased from 1368 t ha^{-1} for September planting to 247 t ha^{-1} for January planting.

2.3 Effect of date of planting on Quality Attributes of vegetable

In a study on watermelon cv. Sugar baby with five different dates of sowing between 10th November to 15th December, reported that total sugar and reducing sugar were significantly more in 20th November sowing than other sowing dates (Desai and Patil 1984).

Farooq (1992) reported that the plant sown in the second week of March gave maximum total soluble salts of muskmelon seeds. Burki (1996) observed that early sowing of tinda seeds give better quality of fruit than late sowing.

Refai et al., (2008) in an experiment for studying the effect of five planting dates i.e., June 15th, July 1st, July 15th, August 1st and August 15th on growth and yield of cantaloupe (*Cucumis melo var. Cantaloupensis*) found that there were highly significant differences among the five planting dates; July 15th planting was the best than the other planting dates for characters like total soluble solids and total sugar content.

2.4 Effect of date of planting on pest and disease incidence

Studies conducted at Kerala Agricultural University revealed that pumpkin crop raised in September–October was found comparatively free from mosaic incidence, whereas the disease intensity was maximum in crop raised in summer months (94-100%) and in June –July (100%). KAU (1994).

2.5 Effect of FYM on growth characters of vegetables

Application of FYM resulted in higher plant height of capsicum (Valsikova and Ivanic, 1982). They also reported that application of chemical fertilizers in the absence of FYM retarded the formation of vegetative organs.

Increase in the growth of chilli, bhindi, tomato and brinjal by organic manure application was reported by Gaur et al., (1984). Gianquinto and Borin (1990) observed an increase in plant growth of tomato plants by the addition of organic manures.

In a study conducted by Montasser (1991) on bhindi, it was revealed that the average length and fresh weight of shoot and root increased considerably in cattle, pigeon, rabbit and sheep manure amended plots. Thamburaj (1994) found that organically grown tomato plants were taller with more number of branches.

According to Arunkumar (1997) FYM application was found to be superior to vermicompost in inducing better plant height in amaranthus.

Raj (1999) reported that growth characters like plant height were higher in organic manure treated okra plots. Arunkumar (2000) observed that highest level of

FYM and vermicompost (150% POP) maintained their superiority at growth stages regarding plant height and number of branches of amaranthus.

Sharma and Sharma (2004) found that application of FYM (10 and 20 t ha^{-1}) in tomato significantly increased the plant height and number of branches $plant^{-1}$ over no application.

According to Shakila and Anburani (2008) combined application of FYM (12.5 t ha^{-1}) + vermicompost (2.5 t ha^{-1}) + panchagavya (3%) foliar spray resulted in improvement of growth characters in tomato. Similar improvement in growth characters was also observed by the application of press mud (6.25 t ha^{-1}) + vermicompost (2.5 t ha^{-1}) + panchagavya (3 %) foliar spray.

A field experiment conducted by Akparobi (2009) revealed that when amaranthus was treated with various farm yard manure levels of 0 t ha^{-1}, 15 t ha^{-1}, 25 t ha^{-1} and 35 t ha^{-1}, treatment with the highest manure level of 35 t ha^{-1} attained the highest plant height of 123.27 cm and those that received no manure treatment reached a maximum height of only 80.20 cm.

2.6 Effect of FYM on yield characters of vegetables

Jagoda et al., (1970) noticed higher yield in cucumber with the application of 300 q ha^{-1} FYM along with 66 kg ha^{-1} chemical nitrogen. Ivanov and Surlekov (1975) showed that cucumber crop receiving a basal dose of 30 t FYM ha^{-1} along with N at 100 and 70 kg ha^{-1} raised the yield by 28.1 and 25.6 per cent respectively compared with untreated control.

For a successful crop of bitter gourd, Katyal (1977) suggested 50 t ha^{-1} FYM and 100 kg ha^{-1} of ammonium sulphate. Subbiah et al., (1983) reported that the yield of brinjal was significantly influenced by levels of FYM (0, 12.5, 25.0 and 37.5 t ha^{-1}) but not by the levels of fertilizer (0, 50, 100, and 150 per cent of recommended dose). Application of 12.5 t ha^{-1} of FYM recorded highest yield of 54.28 t ha^{-1}.

Thomas (1984) reported an increase in mean length of the bitter gourd fruits by the application of organic and inorganic combination. Increase in the yield of chilli, bhindi, tomato and brinjal by organic manure application was reported by Gaur et al., (1984).

A trial conducted by Mesina (1986) in Philippines revealed that application of 10 t cattle dung ha^{-1} along with 120 kg N ha^{-1} as chemical fertilizer increased the number of fruits and yield $plot^{-1}$ of muskmelon by 34% and 84.68% respectively.

In a long-term field experiment for seven years at Jalandhar, Sharma et al., (1988) revealed that FYM was more effective in increasing tuber yield of potato than green manuaring with daincha.

The diameter and weight of the fruits were not however significantly affected by the application of both inorganic and organic fertilizers. Application of 80 t ha^{-1} of cattle manure in conjunction with 100 kg chemical nitrogen at the time of sowing produced the highest fruit yield of 43 t ha^{-1} in melon as reported by Rivera Segovia (1988).

Nair and Peter (1990) reported highest yield in chilli with 15 t FYM and 5:40:25 kg NPK ha^{-1} in the three season trial, when compared to FYM alone or inorganic fertilizer alone. Gianquinto and Borin (1990) observed an increase in yield of tomato plants by the addition of organic manures.

Thamburaj (1994) found that organically grown tomato plants yielded 28.18 t ha^{-1} which was on par with that of the recommended dose of FYM and NPK (20:100:100).

Organic manure like FYM, compost, oil cake, green leaf, poultry manure etc improve the yield as well as quality of vegetable crops like tomato, onion, gourds, chilli etc. (Rani et al., 1997). According to Arunkumar (1997) FYM application was found to be superior to vermicompost in inducing higher yield in amaranthus.

Joseph (1998) observed that in snake guard, yield attributing characters like length, weight and number of fruits plant^{-1} were highest in FYM treated plants as compared to poultry manure or vermicompost treated plants. Senthilkumar and Sekar (1998) reported that fruit yield plant^{-1} in bhindi was increased markedly by FYM application.

Raj (1999) reported that yield attributes like fruit number plant^{-1}, fruit weight, fruit length and fruit yield ha^{-1} were higher in organic manure treated okra plots. Naidu et al., (1999) found that application of NPK @ 80:60:50 kg ha^{-1} + 20 t FYM ha^{-1} in bhindi resulted in increased number of fruits plant^{-1}, weight of fruits plant^{-1} and maximum fruit yield.

An experiment conducted by Dademal and Dongale (1999) on lateritic soils to study the response of bhindi to the application of organic manures and varied levels of chemical fertilizers at Dapoli, revealed that application of FYM @ 7.5 t ha $^{-1}$ along with N P K @ 150, 75 and 75 kg ha $^{-1}$ was most useful for maximization of fruit yield (85.01 q ha $^{-1}$).

The study conducted by Patil et al., (2000) on the effect of organic manures and biofertilizers on yield and quality of bhindi revealed that application of biofertilizers (1 liter slurry) + FYM + 50 kg N ha^{-1}was beneficial for obtaining higher yields of export quality fruits when compared to their individual application.

Rao et al., (2001) studied the effect of organic manures like vermicompost, neem cake, Azospirillum and Phosphobacterium on the growth and yield of brinjal and observed that the highest fruit yield was obtained with the treatment FYM + vermicompost followed by FYM + Neem cake.

A comparative study was conducted by Mangila (2007) et al., to determine the effect of organic fertilizer on the yield of watermelon using chicken dung, cow manure, rice straw and ASG 46. The result of study showed that among the organic fertilizers used cow manure produce (30 fruits) which was more than the control plants (no fertilizer used).

Study conducted by Singh and Mukherjee (2008) on effect of FYM, chemical and biological fertilizers on yield and quality attributes of brinjal revealed that yield increased with the application of FYM and chemical fertilizers at increasing level up to 100 % of recommended dose of N and P + FYM @ 20 t ha^{-1}.

In a field experiment conducted by Sekhar and Rajasree (2009) at Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore to find out the effect of different organic manures on growth, yield and quality attributes of bhindi, it was revealed that among the different organic manure treatments, application of FYM @ 20 t ha^{-1} performed better than the other treatments through improved plant characters viz. number of fruits $plant^{-1}$ (19.3) and yield (10.39 t ha^{-1}) compared to the FYM manure application at lower doses.

An experiment conducted by Eifediyi et al., (2010) to determine the effects of FYM on the growth and yield of cucumber, it was found that the application of FYM at 10 t ha^{-1} produced the highest number of fruits $plant^{-1}$ which was significantly different from the 5 t ha^{-1} and control. Fruit weight and yield increased significantly with increase in the rate of FYM applied. FYM application with the rate of 10 t ha^{-1} out yielded the control plants by 60%.

2.7 Effect of FYM on Quality Attributes of vegetables

Montagu and Ghosh (1990) found that fruit color of tomato was significantly increased as a result of application of organic manures of animal origin. Abusaleha (1992) recommended equal quantity or more organic form of nitrogen for getting good quality okra fruits.

Bhadoria et al., (2002) reported that protein and total mineral content of okra fruit were high, when it was treated with FYM. Omae et al., (2003) reported that cattle compost application increased freshness and vitamin C content in melon.

2.8 Effect of FYM on pest and disease incidence

Dayakar et al., (1995) reported that when FYM was applied along with 50:50 NP fertilizers, the population of pigeon pea pod borers was lower than that under the use of straight inorganic fertilizers alone.

While evaluating the effects of organic manures on the incidence of stem fly in soybean, Kumar et al., (1996) observed least incidence of stem tunneling with FYM application alone (6.45%) and highest with inorganic fertilizer alone (14.87%).

2.9 Effect of FYM on nutrient uptake of vegetables

In an experiment conducted at Kerala Agricultural University on snake gourd, Haris (1989) observed an increase in N and P uptake as the levels of nitrogen application was increased from 50 to 90 kg N ha^{-1}. Application of 90 kg N ha^{-1} registered the maximum K uptake; while the two lower levels i.e. 70 and 90 kg N ha^{-1} did not differ in their effect. Similar trend was noticed by Ravikrishnan (1989) in bitter gourd who reported that N, P, and K uptake increased with increase in levels of N_2 application.

Raju et al., (1991) observed FYM application to be more effective in increasing N uptake in chickpea. Minhas and Sood (1994) found that application of FYM was beneficial in enhancing the uptake of phosphorus by potato and maize. FYM application along with different levels of S, Mo, Fe, Zn and Co increased the uptake of major and micronutrients by cowpea at harvest (Sharma et al., 2002).

2.10 Effect of FYM on soil available nutrients

Havanagi and Mann (1970) in a long term fertilizer experiment under dry farming conditions in Delhi reported that FYM application increased available P_2O_5 content of the soil but not the total nitrogen.

In wheat–maize rotation, available N and P_2O_5 content of the soil increased with continuous use of FYM (Prasad and Singh, 1980). Negi et al., (1981) reported an increase in the available K content of the soil in FYM applied plots compared to fertilizer applied plots. Kanwar and Prihar (1982) reported that continuous application of FYM increased the nitrogen content of soil.

Available K increased slightly with the addition of FYM for a long time (Sharma et al., 1984). Srivastava (1985) observed that increased use of nitrogenous fertilizers decreased total N and available P and K status of soil whereas FYM addition increased all these parameters in the soil. Increased availability of K due to the combined application of FYM with 100% recommended quantity of NPK in the long term fertilizer experiment was reported by Aravind (1987).

Sharma and Sharma (1988) compared the effect of FYM and green manure and inferred that there was a built up of available K which was maximum with the use of

FYM than green manure. Available phosphorus content of soil was significantly increased with the incorporation of FYM.

Dhanorkar et al., (1994) found that continuous use of FYM raised the available K content of soil by 1.3 to 5.4 folds over control.

Issac (1995) reported that available N, P_2O_5 and K_2O contents in the soil were highest with the application of 12 tones of FYM along with vermicompost as a source of nitrogen in bhindi. In another trial, Selvi and Ramaswami (1995) observed increased soil available phosphorus in the post harvest stage of black gram, when FYM was applied as an organic source of nutrient nitrogen.

Patidar and Mali (2002) found that available N and P in soil after sorghum harvest with 10tonnes ha^{-1} FYM application was higher by 9 and 16 % respectively over no FYM application. The increase in N and P in soil was due to the release of N and P on decomposition of FYM. Addition of FYM improved the N, P and K status of soil (Bandgopadhyay and Puste, 2002).

In an incubation study conducted with FYM, Poultry manure and Vermicompost, Nair (2003) reported that there was a progressive increase in the availability of N and P_2O_5 and till the 90^{th} day for all the three manures. In the case of available K_2O for all the three organic manures there was a progressive increase up to the 60^{th} day and there after decreased.

2.11 Effect of FYM on economics of cultivation

Arokiaraj and Kannappan (1995) studied the effect of organic waste on yield and economics of sorghum (CO-25) and reported higher straw yield and grain yield resulting in higher net returns and B: C ratio, by the application of FYM 5 tonnes ha^{-1}.

Materials and Methods

3. MATERIALS AND METHODS

A field Experiment was conducted at College of Agriculture, Vellayani to find out a suitable date of planting and the effect of different doses of FYM on the growth, yield and economics of organic water melon from October 2010 to March 2011. The details of the materials used and the methods adopted are presented in this chapter.

3.1. EXPERIMENTAL SITE

The experiment was carried out at the Instructional Farm attached to the College of Agriculture, Vellayani situated at 8.5 ^{0} North latitude and 76.9 ^{0} East longitude and at an altitude of 29 m above mean sea level.

3.1.1 Soil

The soil of the experimental site was laterite red loam belonging to the order oxisol of Vellayani series. The important chemical properties of the soil and the methods adopted for analysis are presented in Table 1.

Table 1. Chemical composition of the soil at the experimental site

Sl. No	Parameter	Content	Rating	Methods adopted
1	P^H	6.24	Acidic	P^H meter with glass electrode (Jackson,1973)
2	Available N (kg ha^{-1})	313.6	Medium	Alkaline potassium permanganate method (Subbiah andAsija,1956)
3	Available P (kg ha^{-1})	61.16	High	Bray colorimeter method (Jackson ,1973)
4	Available K (kg ha^{-1})	93.2	Low	Neutral normal ammonium acetate method(Jackson,1973)

3.1.2 Cropping History of the Field

The experimental area was kept fallow for more than 3 months before raising the crop.

3.1.3 Season

The experiment was conducted during Rabi 2010-2011 from October to March of 2011.

3.1.4 Weather conditions

The weekly averages of the weather parameters *viz.* maximum and minimum temperature, relative humidity and rainfall received during the cropping period collected from the observatory of College of Agriculture, Vellayani are given in Appendix 1 and illustrated in Fig.1.

3.2 MATERIALS

3.2.1 Cultivar used

The cultivar of watermelon used for the study was Sugar baby. It is an introduction from USA. It is a medium vining variety with fruits weighing 4-6 kg each. Fruits are round in shape, having bluish bloom on dark green skin with black-green stripes; flesh is deep purple, crisp, very sweet (11-13% TSS) with small brown seeds. The fruits ripen 85-90 days after sowing.

3.2.2 Seeds

Seeds of the variety Sugar baby were obtained from Krishi Vigyan Kendra, Thavanur, and Kerala Agricultural University.

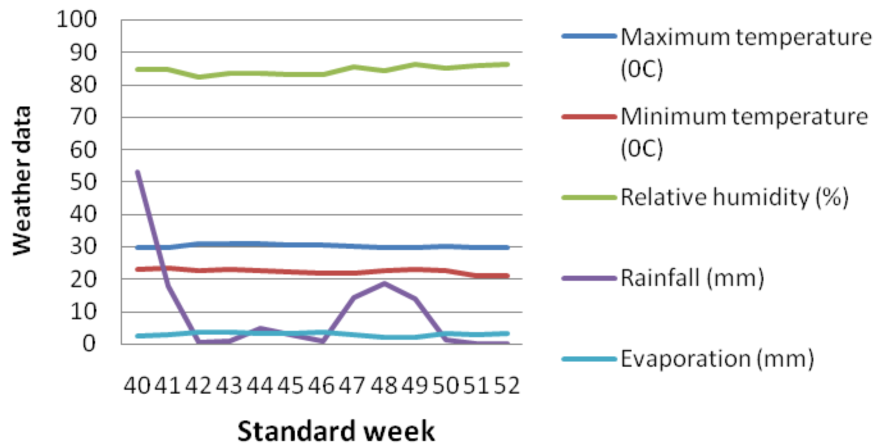

Fig 1a Weather data during the experimental period (Oct 15 to Dec 31)

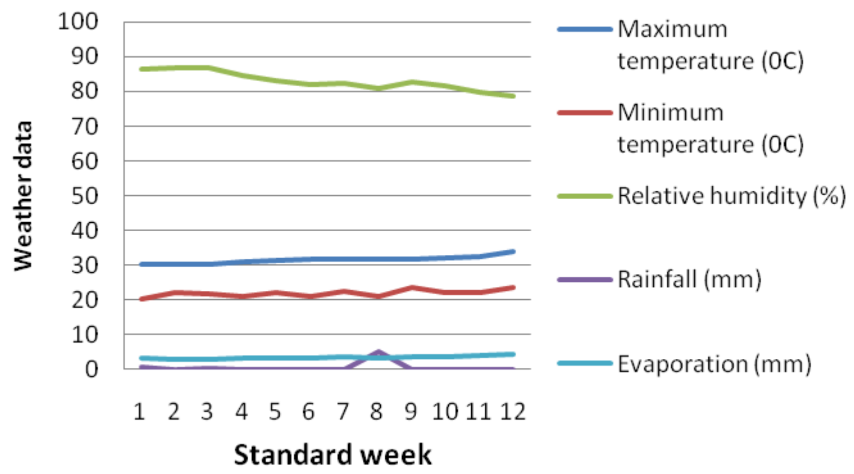

Fig 1b Weather data during the experimental period (Jan 1 to Mar 30)

3.2.3 Manures and Fertilizers

FYM (0.5 % N), was used as organic sources of nitrogen and Urea (46 % N), Rajphos (20 % P_2O_5) and MOP (60 % K) as the inorganic sources of Nitrogen, Phosphorus and Potassium respectively.

3.3 METHODS

3.3.1 Design and Lay out

The lay out of the experiment is presented in Fig. 2

General view of the experimental field is given in Plate 1.

Design : Split plot

Treatments : 20

Replication : 4

Plot Size : 12 m^2

Spacing : 2 x 0.5m

Total number of plots: 80

3.3.2 Treatments

Main plot (Date of planting)

1. D_1- October 15^{th}
2. D_2- November 1^{st}
3. D_3- November 15^{th}
4. D_4- December 1^{st}
5. D_5- December 15^{th}

Sub plot (Levels of nutrients)

1. T_1-5 kg FYM $plant^{-1}$
2. T_2-4 kg FYM $plant^{-1}$
3. T_3-3 kg FYM $plant^{-1}$
4. T_4-2 kg FYM $plant^{-1}$ + 7:2.5:2.5 g NPK $plant^{-1}$ [control]- POP Recommended dose of KAU

Fig.2. Lay out Plan of the Experiment

Replication I

D_1T_1	**D_1T_2**	**D_1T_3**	**D_1T_4**
D_2T_4	**D_2T_3**	**D_2T_2**	**D_2T_1**
D_3T_2	**D_3T_1**	**D_3T_4**	**D_3T_3**
D_4T_4	**D_4T_3**	**D_4T_2**	**$D_4 T_1$**
D_5T_2	**D_5T_1**	**D_5T_4**	**D_5T_3**

Replication II

D_1T_2	**D_1T_4**	**D_1T_3**	**D_1T_1**
D_2T_3	**D_2T_1**	**D_2T_2**	**D_2T_4**
D_3T_4	**D_3T_3**	**D_3T_1**	**D_3T_2**
D_4T_1	**D_4T_2**	**D_4T_3**	**D_4T_4**
D_5T_3	**D_5T_4**	**D_5T_1**	**D_5T_2**

Replication III

D_1T_2	**$D1T_3$**	**D_1T_4**	**D_1T_1**
D_2T_4	**D_2T_1**	**D_2T_2**	**D_2T_3**
D_3T_2	**D_3T_3**	**D_3T_4**	**D_3T_1**
D_4T_1	**D_4T_4**	**D_4T_2**	**D_4T_3**
D_5T_2	**D_5T_3**	**$D5T_1$**	**D_5T_4**

Replication IV

D_1T_1	**D_1T_2**	**D_1T_3**	**D_1T_4**
D_2T_3	**D_2T_4**	**D_2T_1**	**D_2T_2**
D_3T_4	**D_3T_2**	**D_3T_3**	**D_3T_1**
D_4T_3	**D_4T_1**	**D_4T_4**	**D_4T_2**
D_5T_4	**D_5T_2**	**D_5T_3**	**D_5T_1**

General view of experimental field

Treatment Combinations:

D_1T_1	D_1T_2	D_1T_3	D_1T_4
D_2T_1	D_2T_2	D_2T_3	D_2T_4
D_3T_1	D_3T_2	D_3T_3	D_3T_4
D_4T_1	D_4T_2	D_4T_3	D_4T_4
D_5T_1	D_5T_2	D_5T_3	D_5T_4

The following organic practices were uniformly adopted for all treatments:

1. Need based application of *Pseudomonas fluorescens* (2% solution) – for disease management.
2. Need based application of neem oil garlic extract (2 %) – for pest management.

3.4 CROP HUSBANDRY

3.4.1 Land Preparation

The experimental area was cleared of weeds and stubbles. The field was laid out as per the design and individual plots were dug well and leveled. In the plots of 12 m^2size, pits were taken at 2 x 0.5 m spacing for sowing seeds. The experiment plot was made into main plots and sub plots as per treatment. The different dates of planting were assigned in the main plot and the four levels of nutrients in the subplots.

3.4.2 Application of Manures and Fertilizers

Farm yard manure was applied as per the treatment as basal dose. The POP recommended dose of fertilizer @70:25:25 kg N P_2O_5 and K_2O was applied as inorganic fertilizer. Half N, full P and K were applied as basal and remaining N at flowering stage.

3.4.3 Other management practices:

Dried coconut leaves and banana leaves were spread on the interspaces of the channels and vines were allowed to trail on it. Regular weeding operations were carried out to keep the plot free of weeds and crops were irrigated everyday.

3.4.4 Harvest

Harvesting started when fruit reached mature stage as judged by visual observation. The maturity indices were changing the colour of the fruit portion touching the ground to yellow, drying of the nearest tendrils and hearing a dull sound on tapping the fruits.

3.5 OBSERVATIONS

Four plants were selected as observational plants from each plot. From these plants biometric observations and yield attributes were recorded.

3.5.1 Vegetative characters

3.5.1.1 **Branches plant $^{-1}$**

The number of main branches plant^{-1} was counted at 30 DAS and at harvest and the average was worked out.

3.5.1.2 **Main vine length (cm)**

Length from the collar region to the tip of the main vine was measured at 30 DAS, 60 DAS and at harvest and expressed in centimeters.

3.5.2 Flowering and earliness

3.5.2.1 **Days to first male flower opening**

Number of days taken from sowing to the blooming of first male flower was recorded.

3.5.2.2 **Days to first female flower opening**

Number of days taken from sowing to the blooming of first female flower was recorded.

3.5.2.3 **Node to first female flower opening**

The nodes were counted from the lowest portion to the one at which the first female flower opened and recorded.

3.5.2.4 **Days to first harvest**

Duration from sowing to first harvest of the fruits from each treatment was recorded.

3.5.2.5 **Crop duration (days)**

Number of days taken from sowing to the harvest of the last fruit was considered as duration of crop.

3.5.2.6 **Number of female flowers plant**$^{-1}$

The total number of female flowers plant^{-1} was counted and average worked out.

3.5.3 Yield

3.5.3.1 **Total fruits plant**$^{-1}$

The total fruits from observation plants were counted and average worked out.

3.5.3.2 **Total fruits hactare^{-1}**

The total number of fruits from each plot in all treatment was counted and total fruit in hactare was worked out.

3.5.3.3 **Marketable fruit plant^{-1}**

The number of saleable fruits were counted from observation plants and average recorded.

3.5.3.4 **Marketable yield hactare^{-1}**

The weights of marketable fruits from each plot at all harvest were taken and marketable yield in hactare was worked out and expressed in kilograms.

3.5. 3.5 **Marketable fruits hactare $^{-1}$**

The number of fruits saleable from each plot and each treatment was recorded and marketable fruit in hactare was worked out.

3.5.3.6 **Unmarketable fruits hactare^{-1}**

Deformed and diseased fruits were counted and unmarketable fruit in hactare was worked out.

3.5.4 Fruit characters

For observation on fruit characters four fruits per replication were taken and average worked out.

3.5.4.1 **Average fruit weight (kg)**

The fruits from each plot were taken, weighed and their average worked out and expressed in kilograms.

3.5.4.2 **Fruit length (cm)**

The length of the fruit was measured from the stalk end of the tip in all the observational fruits and expressed in centimeters.

3.5.4.3 **Fruit diameter (cm)**

After cutting the fruits into two halves diameter at the middle of the fruits including the rind was worked out and expressed in centimeters.

3.5.4.4 **Fruit thickness (cm)**

After cutting the fruits into two halves diameter at the middle of the fruits excluding the rind was measured using scale, the average worked out and expressed in centimeters.

3.5.4.5 **Rind thickness (cm)**

The difference between the fruit diameter and flesh thickness was calculated and expressed in centimeters.

3.5.4.6 **Fruit girth (cm)**

Fruit girth was measured by encircling a twine around the middle portion of the fruit and the twine length was measured using a scale and expressed in centimeters.

3.5.4.7 **Seeds fruit $^{-1}$**

The numbers of seeds from each of the four observation fruits were counted and the average worked out.

3.5.4.8 **100 seed weight (gm)**

100 fully developed seeds of the observational fruits were weighed and recorded in grams.

3.5.5 Quality

3.5 5.1 **Total soluble solids**

Using refractometer the total soluble solids from the fruits of each treatment were taken, average worked out and expressed as percentage.

3.5.5.2 **Total sugar**

Fruit juice of the observation plants was extracted and the total sugar were estimated as per Sadasivam and Manikam (1992).

3.5.5.3 **Reducing sugar**

The extracted fruit juices of the observation plants were subjected for reducing sugar estimation as per Sadasivam and Manikam (1992).

3.5.5.4 **Non-reducing sugar**

From the fruit juice of observation plants non-reducing sugar was estimated as per Sadasivam and Manikam (1992).

3.5.5.5 **Iron content (mg/100g)**

The iron content from fruits of observational plants of each treatment was analyzed by Spectrophotometer after wet digestion of the samples using di-acid mixture.

3.5.5.6 **Organoleptic test (Score)**

Organoleptic test was conducted to rate the appearance, texture, flavour and taste of the ripe fruit. A panel of 5 members tested the organoleptic qualities and expressed their opinion in a score card.

3.5.6 Plant Analysis

Sample plants collected from each plot at harvest were chopped, sun dried and oven dried to a constant weight. Samples were ground to pass through a 0.5 mm mesh in a Willey Mill and the required quantity of samples were digested and used for nutrient content analysis.

3.5.6.1 **Uptake of Nitrogen**

The nitrogen content in plant samples was estimated by the modified microkjeldhal method (Jackson, 1973) and the uptake of nitrogen was calculated by multiplying the nitrogen content of plant sample with the total dry weight of plants. The uptake values were expressed in kg ha^{-1}.

3.5.6.2 **Uptake of Phosphorus**

The phosphorus content in the plant sample was colorimetrically determined by wet digestion of the sample and developing colour by ascorbic acid method and read in a Spectrophotometer (Bray and Kurtz 1964). The uptake of phosphorus was calculated by multiplying the phosphorus content of plant sample with the total dry weight of plants. The uptake values were expressed in kg ha^{-1}.

3.5.6.3 ***Uptake of Potassium***

The potassium content in the plant sample was determined by flame photometer method and the uptake of Potassium was calculated by multiplying the potassium content of plant sample with the total dry weight of plants. The uptake values were expressed in kg ha^{-1}.

3.5.7 Soil Analysis

Soil samples were taken from the experimental area before the lay out of the experiment and after the experiment. The air dried samples were analysed for available nitrogen by the alkaline Potassium permanganate method (Subbiah and Asija, 1956), available phosphorus by Bray's colorimeter method and available potassium by ammonium acetate method (Jackson, 1973).

3.5.8 Incidence of Pests and Diseases

The pests and the diseases incidence did not reach the threshold level and hence uniform score was given to all plots.

3.6.8 Economics Analysis

The economics of cultivation using the treatments was worked out considering the total cost of cultivation and the prevailing market price of the produce. The net returns and the benefit –cost ratio were computed as follows:

$$\text{Net returns} = \text{Gross Income} - \text{Cost of cultivation}$$

$$B:C = \frac{\text{Gross Income}}{\text{Cost of cultivation}}$$

Results

4. RESULTS

A field experiment to find out a suitable date of planting and the effect of different dose of FYM on the growth, yield and economics of organic watermelon was conducted at the Instructional Farm, attached to College of Agriculture, Vellayani during the period from October 2010 to March, 2011. The experimental data collected were statistically analyzed and the results obtained are presented below.

4.1 VEGETATIVE CHARACTERS

4.1.1 Branches plant^{-1}

The number of branches plant^{-1} are influenced by different treatments is presented in Tables 2 and 3.

At 30DAS the number of branches plant^{-1} was not significantly influenced by different dates of planting, application of different dose of FYM and their interaction.

At harvest the number of branches plant^{-1} was significantly influenced by different dates of planting, application of different dose of FYM and their interaction.

Significantly higher number of branches plant^{-1} (4.25) was noticed in earlier dates of planting (October 15th) and it was on par with all other dates of planting except December 15th which recorded lowest number of branches plant^{-1}(3.08).

Significantly higher number of branches plant^{-1} (4.67) was noticed in plots treated with 5 kg FYM plant^{-1}. The lowest number of branches plant^{-1} were

Table 2. Effect of date of planting and levels of FYM on branches plant $^{-1}$ at 30 DAS

	N_1	N_2	N_3	N_4	Mean
D_1	2.33	2.16	2.16	2.00	2.16
D_2	2.33	2.50	2.16	2.33	2.33
D_3	2.16	1.50	2.00	2.00	1.91
D_4	2.33	2.16	1.83	2.00	2.08
D_5	1.83	1.50	1.33	2.00	1.66
Mean	2.20	1.96	1.90	2.07	

	D	N	DN
F	3.13	2.62	1.34
CD	NS	NS	NS
SE	0.143	0.081	0.070

NS - Non significant

Table 3. Effect of date of planting and levels of FYM on branches plant $^{-1}$ at harvest

	N_1	N_2	N_3	N_4	Mean
D_1	5.67	4.33	3.67	3.33	4.25
D_2	5.17	4.67	3.67	3.33	4.21
D_3	4.33	3.33	3.83	3.33	3.71
D_4	4.67	4.33	3.33	3.17	3.88
D_5	3.50	3.33	2.83	2.67	3.08
Mean	4.67	4.00	3.47	3.17	

	D	N	DN
F	6.91*	37.76**	2.42*
CD	0.586	0.309	0.691
SE	0.179	0.107	0.092

** Significant at 1 per cent level

* Significant at 5 per cent level

recorded by 2kg FYM plant^{-1} (3.17) and it was on par with 3 kg FYM plant^{-1} (3.47).

Maximum number of branches plant^{-1} was noticed in D_1N_1 (October 15th planting with 5 kg FYM plant^{-1}) 5.67 and minimum in D_5N_4 (December 15th with POP recommendation) 2.67.

4.1.2 Main vine length (cm)

The average vine lengths at 30DAS, 60 DAS and at harvest are presented in Tables 4, 5 and 6.

At 30DAS the main vine length was not significantly influenced by different dates of planting, application of different dose of FYM and their interaction.

At 60DAS the main vine length was significantly influenced by different dates of planting. The maximum vine length was recorded by November 1st planting (243.96) and it was on par with other planting dates except December 15th planting. Minimum vine length was noticed in the December 15th planting (163.71) which was significantly lower than other planting dates.

But different FYM levels and its interaction with different planting dates could not significantly influence main vine length at 60 DAS.

Different dates of planting and different levels of FYM cause significant influence on main vine length at harvest.

At harvest maximum vine length was recorded by October 15th planting (386.25) and it was on par with November 1st planting (380.83). Minimum vine

Table 4. Effect of date of planting and levels of FYM on main vine length (cm) at 30 DAS

	N_1	N_2	N_3	N_4	Mean
D_1	53.50	52.33	40.83	50.16	49.20
D_2	52.66	54.50	65.00	38.16	52.58
D_3	47.66	43.83	41.00	51.00	45.87
D_4	52.16	54.00	58.16	52.66	54.25
D_5	47.66	55.16	41.66	57.66	50.54
Mean	50.73	51.96	49.33	49.93	

	D	N	DN
F	2.11	0.382	3.860
CD	NS	NS	NS
SE	2.212	1.840	1.594

NS - Non significant

Table 5. Effect of date of planting and levels of FYM on main vine length (cm) at 60 DAS

	N_1	N_2	N_3	N_4	Mean
D_1	223.00	234.83	222.00	245.17	231.25
D_2	242.83	242.83	268.17	222.00	243.96
D_3	235.67	231.50	228.83	219.67	228.92
D_4	263.67	239.00	230.33	220.17	238.29
D_5	162.83	173.33	150.50	168.17	163.71
Mean	225.60	224.30	219.97	215.03	

	D	N	DN
F	28.38**	0.727	1.353
CD	20.014	NS	NS
SE	6.137	5.603	4.853

** Significant at 1 per cent level

NS - Non significant

length was noticed in the December 15th planting (249.42) which was significantly lower than other planting dates.

Vine length was significantly different with regard to FYM levels. Maximum vine length was noticed with 5 kg FYM plant^{-1}(359.77) and it was on par with 4 kg FYM plant^{-1} (345.57). The minimum vine length was noticed with 3kg FYM plant^{-1} (306.93) and it was on par with POP recommendation (308.5).

The interaction effect between the different dates of planting and different levels of FYM did not show any significant variation in main vine length at harvest.

4.2 FLOWERING AND EARLINESS OF WATERMELON

4.2.1 Days to opening of first male flower

The days to first male flower opening is given in Table 7.

Days to first male flower opening was significantly influenced by different dates of planting. Among the planting dates December 1st took minimum number of days to flower opening (31.96) and it was on par with December 15th planting (32.5). More number of days for flower opening was reported by November 1st planting (39.04).

But different FYM levels and its interaction with different planting dates could not significantly influence days to first male flower opening.

4.2.2 Days to first female flower opening

Days to first female flower opening is given in Table 8.

Table 6. Effect of date of planting and levels of FYM on main vine length (cm) at harvest

	N_1	N_2	N_3	N_4	Mean
D_1	420.00	405.83	346.67	372.50	386.25
D_2	403.33	396.67	373.33	350.00	380.83
D_3	378.83	345.83	281.50	265.67	317.96
D_4	341.33	316.67	305.67	302.33	316.50
D_5	255.33	262.83	227.50	252.00	249.42
Mean	359.77	345.57	306.93	308.50	

	D	N	DN
F	43.99**	12.476**	1.355
CD	27.560	21.750	NS
SE	8.534	7.479	6.477

** Significant at 1 per cent level

NS - Non significant

Table 7. Effect of date of planting and levels of FYM on days to first male flower opening

Treatments	N_1	N_2	N_3	N_4	Mean
D_1	38.50	38.83	37.17	38.50	38.25
D_2	39.17	38.50	39.00	39.50	39.04
D_3	36.33	34.67	35.50	34.83	35.33
D_4	32.00	30.83	32.33	32.67	31.96
D_5	31.33	33.17	32.50	33.00	32.50
Mean	35.47	35.20	35.30	35.70	

	D	N	DN
F	258.46**	0.404	1.005
CD	0.655	NS	NS
SE	0.200	0.343	0.297

NS - Non significant

** Significant at 1 per cent level

Table 8. Effect of date of planting and levels of FYM on days to first female flower opening

	N_1	N_2	N_3	N_4	Mean
D_1	44.67	45.67	44.00	44.33	44.67
D_2	45.17	44.33	45.17	45.33	45.00
D_3	42.00	41.17	42.50	41.50	41.79
D_4	38.33	36.67	38.17	37.83	37.75
D_5	37.50	39.00	38.83	39.00	38.58
Mean	41.53	41.37	41.73	41.60	

	D	N	DN
F	52.286**	0.1922	0.842
CD	1.511	NS	NS
SE	0.463	0.347	0.301

** Significant at 1 per cent level

NS - Non significant

Table 9. Effect of date of planting and levels of FYM on node to first female flower

	N_1	N_2	N_3	N_4	Mean
D_1	11.83	12.50	13.00	14.33	12.92
D_2	13.50	11.17	13.67	12.00	12.58
D_3	11.50	10.50	13.17	12.33	11.88
D_4	12.67	12.17	12.17	13.17	12.54
D_5	13.83	13.83	12.50	14.67	13.71
Mean	12.67	12.03	12.90	13.30	

	D	N	DN
F	0.727	0.919	0.573
CD	NS	NS	NS
SE	0.782	0.553	0.478

NS - Non significant

The different planting dates could significantly influence the days to first female flower opening. The plants of December 1st planting (37.75) was the first to flower which was on par with December 15th planting (38.58) and November 1st planting took more days (45) for flowering.

There was no significant difference observed on days to first female flower opening with respect to different levels of FYM and its interaction with different planting dates.

4.2.3 Node to first female flower

The different dates of planting, different levels of FYM, and their interaction could not significantly influence the node to first female flower (Table 9).

4.2.4 Days to first harvest

Different planting dates and FYM levels could significantly influence the days to first harvest. (Table 10)

December 1st planting took minimum days to first harvest (68 days) and it was on par with December 15th planting. October 15th planting took maximum days to first harvest.

N_4 (POP recommendation) noticed minimum number of days to first harvest and it was on par with N_3 (3 kg FYM plant^{-1}). N_1 (5 kg FYM plant^{-1}) reported maximum number of days to first harvest and was significantly superior to other FYM levels.

The interaction effect between the different planting dates and FYM levels did not show any significant variation in days to first harvest.

4.2.5 Crop duration

Crop duration was significantly influenced by different planting dates and FYM levels. (Table 11).

December 1st planting took minimum crop duration of 87.16 days and it was on par with December 15th planting. October 15th took maximum crop duration and it was on par with November 1st planting.

N_4 (POP recommendation) registered minimum crop duration. N_1 (5 kg FYM plant^{-1}) reported maximum crop duration and was significantly superior to other FYM levels.

The interaction effect of the different planting dates and FYM levels did not show any significant variation in crop duration.

4.2.6 Female Flowers Plant^{-1} (No.)

The number of flowers plant^{-1} is presented in Table 12.

Different planting dates showed a marked variation on number of female flowers plant^{-1}. The highest number of female flowers plant^{-1} (11) was recorded by D_1 which was on par with D_2 (10.58) and lowest number of flowers was observed in D_5 (9.13).

The different FYM levels and interaction effect of different dates of planting and levels of FYM did not impart any significant variation on the number of female flowers plant^{-1}.

Table 10. Effect of date of planting and levels of FYM on days to first harvest

	N_1	N_2	N_3	N_4	Mean
D_1	81.83	79.00	77.50	76.67	78.75
D_2	81.50	77.67	76.00	75.83	77.75
D_3	75.50	75.00	71.83	71.17	73.38
D_4	70.17	68.83	66.83	66.17	68.00
D_5	71.17	70.33	67.17	66.67	68.83
Mean	76.03	74.17	71.87	71.30	

	D	N	DN
F	30.730**	69.797**	1.129
CD	2.905	0.754	NS
SE	0.890	0.261	0.5838

** Significant at 1 per cent level

NS - Non significant

Table 11. Effect of date of planting and levels of FYM on crop duration

	N_1	N_2	N_3	N_4	Mean
D_1	102.50	99.66	96.50	95.00	98.41
D_2	102.80	98.00	94.33	93.50	97.16
D_3	96.17	95.33	90.83	89.50	92.95
D_4	90.83	88.50	85.50	83.83	87.16
D_5	91.83	89.66	85.83	84.67	88.00
Mean	96.83	94.23	90.60	89.30	

	D	N	DN
F	31.45**	120.449	0.964
CD	2.985	0.904	NS
SE	0.915	0.313	0.699

** Significant at 1 per cent level

NS - Non significant

Table 12. Effect of date of planting and levels of FYM on female flower plant $^{-1}$

	N_1	N_2	N_3	N_4	Mean
D_1	10.50	11.33	10.67	11.50	11.00
D_2	11.33	10.00	10.50	10.50	10.58
D_3	8.67	9.67	9.33	9.33	9.25
D_4	9.83	9.17	10.17	10.67	9.96
D_5	8.50	8.83	9.67	9.50	9.13
Mean	9.77	9.80	10.07	10.30	

	D	N	DN
F	17.310**	0.7160	0.6340
CD	0.640	NS	NS
SE	0.196	0.295	0.256

** Significant at 1 per cent level

NS - Non significant

Table 13. Effect of date of planting and levels of FYM on total fruit plant $^{-1}$

	N_1	N_2	N_3	N_4	Mean
D_1	2.33	1.67	1.83	1.83	1.92
D_2	1.83	1.67	1.17	1.33	1.50
D_3	1.58	1.25	1.67	1.42	1.48
D_4	1.58	1.50	1.33	1.17	1.40
D_5	1.50	1.42	1.08	1.25	1.31
Mean	1.76	1.50	1.41	1.40	

	D	N	DN
F	8.4797**	4.5867**	1.0720
CD	0.261	0.228	NS
SE	0.0801	0.0792	0.1771

** Significant at 1 per cent level

NS- Non significant

Table 14. Effect of date of planting and levels of FYM on total fruit ha $^{-1}$

	N_1	N_2	N_3	N_4	Mean
D_1	14199.00	10026.50	11025.00	11005.00	11563.88
D_2	11184.67	10083.33	7959.00	8021.00	9312.00
D_3	9726.83	7686.03	10193.25	8513.50	9029.92
D_4	9701.83	9017.92	8271.00	8376.17	8841.73
D_5	9009.58	8505.83	6874.33	7694.00	8020.94
Mean	10764.38	9063.93	8864.52	8721.93	

	D	N	DN
F	13.05**	4.4*	0.96
CD	1196.94	1309.08	NS
SE	367.03	453.31	1013.63

*Significant at 5 per cent level

** Significant at 1 per cent level

NS- Non significant

Table 15. Effect of date of planting and levels of FYM on marketable fruit plant $^{-1}$

	N_1	N_2	N_3	N_4	Mean
D_1	2.08	1.42	1.58	1.58	1.67
D_2	1.58	1.42	1.08	1.08	1.29
D_3	1.33	1.08	1.42	1.17	1.25
D_4	1.33	1.25	1.17	1.00	1.19
D_5	1.25	1.17	1.00	1.08	1.13
Mean	1.52	1.27	1.25	1.18	

	D	N	DN
F	10.6462**	4.3538*	0.9575
CD	0.212146	0.2023	NS
SE	0.0651	0.0701	0.1566

*Significant at 5 per cent level

** Significant at 1 per cent level

NS- Non significant

4.3 YIELD ATTRIBUTES

4.3.1 Total fruit plant^{-1}

The total fruit plant^{-1} is presented in Table 13. The different planting dates and levels of FYM application significantly influenced the total fruit plant^{-1} but their interaction was not significant.

The highest number of fruits plant^{-1} was recorded by the D_1 (1.92) which was significantly superior to other dates of planting. The minimum number of fruits was recorded by D_5 (1.31) and it was on par with all other dates of planting except D_1.

The highest number of total fruit plant^{-1} was recorded by N_1 (1.76). The lowest number of fruits was recorded by N_4 (1.40) and it was on par with all other FYM levels except N_1.

4.3.2 Total Fruit hactare^{-1}

The total fruit hactare^{-1} is presented in Table 14.

The total fruit hactare^{-1} was significantly influenced by the different planting dates. The highest number of total fruit hactare^{-1} was recorded by October 15th planting (11563.87). The lowest fruit hactare^{-1} was recorded by December 15th planting (8020.93).

The total fruit hactare^{-1} was significantly influenced by different FYM levels. The highest number of total fruit hactare^{-1} was recorded by N_1 (10764.38). The lowest fruit hactare^{-1} was recorded by N_4 (8721.93).

The interaction effect between different planting dates and different FYM levels was not significant.

4.3.3 Marketable fruits plant^{-1}

The marketable fruits plant^{-1} is given in Table 15.

The different planting dates significantly influenced the marketable fruits plant^{1}. D_1 (1.67) recorded significantly higher number of marketable fruits plant^{-1} compared to the other treatments and D_5 (1.13) recorded the lowest which was on par with other planting dates except D1.

The different FYM levels significantly influenced the marketable fruits plant^{-1}. N_1 (1.52) recorded significantly higher number of marketable fruits plant^{-1} compared to the other treatments and N_4 (1.18) recorded the lowest which was on par with other planting dates except N_1.

The interaction between different planting dates and different FYM levels could not significantly influence marketable fruits plant^{-1}.

4.3.4 Marketable fruits hactare^{-1}

The marketable fruits hactare^{-1} was recorded and the data is given in Table 16. The different planting dates could significantly influence the marketable fruits hactare^{-1}.

The highest number of marketable fruit hactare^{-1} was recorded by D_1 (10568.96). The lowest number of marketable fruit hactare^{-1} was recorded by D_5 (7012.92).

The different FYM levels could significantly influence the marketable fruits hactare^{-1}. The highest value of marketable fruit hactare^{-1} was recorded by N_1 (9709.48). The lowest value of marketable fruit hactare^{-1} was recorded by N_4 (7748.33) which were on par with other FYM levels except $N_{1.}$

Table 16. Effect of date of planting and levels of FYM on marketable fruit ha^{-1}

	N_1	N_2	N_3	N_4	Mean
D_1	12833.33	9218.75	10307.08	9916.67	10568.96
D_2	9530.33	9137.33	7047.67	6933.33	8162.17
D_3	9040.33	7052.92	9222.50	7841.67	8289.35
D_4	9005.42	8137.50	7591.33	7883.33	8154.00
D_5	8138.00	7240.00	6507.00	6166.67	7012.92
Mean	9709.48	8157.30	8135.12	7748.33	

	D	N	DN
F	11.0628**	4.3066*	0.7873
CD	1273.731	1208.564	NS
SE	390.5741	418.5033	935.8019

*Significant at 5 per cent level

** Significant at 1 per cent level

NS- Non significant

Table 17. Effect of date of planting and levels of FYM on marketable yield ha^{-1} (kgha^{-1})

	N_1	N_2	N_3	N_4	Mean
D_1	48725.00	26683.85	33364.15	27558.33	34082.83
D_2	34763.75	25822.67	20871.87	20735.00	25548.32
D_3	27020.23	20887.69	27856.38	19836.25	23900.14
D_4	25426.85	22893.96	20767.83	19717.50	22201.54
D_5	21774.03	20014.67	17462.32	15258.33	18627.34
Mean	31541.97	23260.57	24064.51	20621.08	

	D	N	DN
F	20.2117**	8.4015**	1.3267
CD	4172.875	4666.269	NS
SE	1279.5613	1615.8425	3613.1337

*Significant at 5 per cent level

** Significant at 1 per cent level

NS- Non significant

Different FYM levels and planting dates did not significantly interact with each other in the case of marketable fruits hactare^{-1}.

4.3.5 Marketable yield hactare^{-1}

The marketable yield hactare^{-1} was recorded and the data is given in Table 17. The different planting dates could significantly influence the marketable yield hactare^{-1}.

The highest marketable fruit yield hactare^{-1} was recorded by D_1 (34082.83) and the lowest fruit yield hactare^{-1} was recorded by D_5 (18627.34).

The different FYM levels could significantly influence the marketable fruits yield hactare^{-1}. The highest value of marketable fruit yield hactare^{-1} was recorded by N_1 (31541.97) which showed significant difference from all other treatments. This was followed by N_3 (24064.51), N_2 (23260.57) and N_4 (20621.08) and were on par with each other.

The interaction effect of planting dates and FYM levels on marketable fruit yield hactare^{-1} was not significant.

4.3.6 Unmarketable fruits hactare^{-1}

There was no significant difference observed on unmarketable fruit hactare^{-1} with respect to different planting dates, FYM levels and their interaction (Table18).

4.4 FRUIT CHARACTERS

4.4.1 Average fruit weight (kg)

Table 18. Effect of date of planting and levels of FYM on unmarketable fruit ha^{-1}

	N_1	N_2	N_3	N_4	Mean
D_1	1365.67	807.75	717.92	1088.33	994.92
D_2	1654.33	946.00	911.33	1087.67	1149.83
D_3	686.50	633.17	970.75	671.83	740.56
D_4	696.42	880.42	679.67	492.83	687.33
D_5	871.58	1265.83	367.33	1527.33	1008.02
Mean	1054.90	906.63	729.40	973.60	

	D	N	DN
F	0.6732	0.6340	0.6833
CD	NS	NS	NS
SE	237.9356	173.8988	388.8496

NS-Non Significant

Table 19. Effect of date of planting and levels of FYM average fruit weight (kg)

	N_1	N_2	N_3	N_4	Mean
D_1	3.78	2.93	3.10	2.82	3.16
D_2	3.65	2.82	2.95	2.98	3.10
D_3	3.00	2.96	3.02	2.52	2.87
D_4	2.82	2.80	2.75	2.52	2.72
D_5	2.68	2.74	2.68	2.48	2.65
Mean	3.19	2.85	2.90	2.66	

	D	N	DN
F	7.521**	9.938**	1.926
CD	0.267	0.198	NS
SE	0.0821	0.0686	0.0594

**Significant at 1 per cent level

NS - Non significant

Table 20. Effect of date of planting and levels of FYM average fruit length (cm)

	N_1	N_2	N_3	N_4	Mean
D_1	19.23	18.33	18.23	18.10	18.48
D_2	19.10	18.33	18.43	18.50	18.59
D_3	18.53	18.46	18.57	17.47	18.26
D_4	18.27	18.26	18.17	17.53	18.06
D_5	17.90	18.03	17.90	17.43	17.86
Mean	18.61	18.28	18.26	17.81	

	D	N	DN
F	3.27	6.927**	1.014
CD	NS	0.361	NS
SE	0.1729	0.125	0.2794

**significant at 1per cent level

NS - Non significant

Table 21.Effect of date of planting and levels of FYM average fruit diameter(cm)

	N_1	N_2	N_3	N_4	Mean
D_1	19.67	17.53	18.00	17.30	18.13
D_2	19.40	17.13	17.50	17.63	17.92
D_3	17.67	17.80	17.70	16.40	17.39
D_4	17.10	17.10	17.00	16.47	16.92
D_5	16.80	16.90	16.77	16.40	16.72
Mean	18.13	17.29	17.39	16.84	

	D	N	DN
F	8.122**	9.148**	2.130*
CD	0.99	0.509	1.138
SE	0.3035	0.1763	0.3940

**Significant at 1 per cent level

* Significant at 5 per cent level

The average weight of fruits is presented on Table 19.

The different dates of planting showed a profound influence on average fruit weight. It was highest at D_1 (3.16) which were on par with D2 (3.1) and the lowest at D_5 (2.65) which were on par with D_3 (2.87) and D_4 (2.72).

Significant difference between the FYM levels on average fruit weight was observed. It was highest in N_1 (3.19) and the lowest in N_4 (2.66) which was on par with N_2 (2.85).

Different planting dates and FYM levels did not significantly interact with each other in the case of average weight of fruits.

4.4.2 Fruit length (cm)

The data on fruit length is presented in Table 20. Different planting dates did not cause any significant influence on fruit length.

The fruit length was significantly influenced by different FYM levels. It was longest in N_1 (18.61) which were on par with N_2 (18.28) and N_3 (18.26). It was shortest in N_4 (17.81) and was significantly shorter than other FYM levels.

The interaction effect between the different planting dates and FYM levels did not show any significant variation in fruit length.

4.4.3 Fruit diameter (cm)

The fruit diameter is given in Table 21.

Different planting dates recorded significant variation in fruit diameter. Maximum fruit diameter (18.13) was noticed in October 15th planting D_1 and it

Table 22. Effect of date of planting and levels of FYM on flesh thickness (cm)

	N_1	N_2	N_3	N_4	Mean
D_1	17.33	15.31	15.67	15.09	15.85
D_2	17.11	14.66	15.01	15.17	15.49
D_3	15.39	15.47	15.42	14.15	15.11
D_4	14.82	14.85	14.63	14.26	14.64
D_5	14.51	14.55	14.25	13.67	14.24
Mean	15.83	14.97	14.99	14.47	

	D	N	DN
F	10.371**	10.402**	2.106
CD	0.651	0.507	NS
SE	0.1995	0.1756	0.1520

**Significant at 1 per cent level

NS - Non significant

Table 23. Effect of date of planting and levels of FYM on rind thickness (cm)

	N_1	N_2	N_3	N_4	Mean
D_1	2.34	2.22	2.33	2.21	2.27
D_2	2.28	2.47	2.49	2.46	2.43
D_3	2.27	2.32	2.28	2.25	2.28
D_4	2.28	2.25	2.36	2.20	2.27
D_5	2.29	2.34	2.52	2.73	2.47
Mean	2.29	2.32	2.39	2.37	

	D	N	DN
F	2.340	1.990	2.140
CD	NS	NS	NS
SE	0.624	0.033	0.0744

NS - Non significant

was on par with D_2 (17.92). D_5 (16.72) recorded minimum fruit diameter value which was on par with D_4 (16.92) and D_3 (17.39).

The effect of different FYM levels varied significantly in fruit diameter. Maximum fruit diameter was recorded in N_1 (18.13) which were significantly superior to other FYM levels. Minimum fruit diameter was recorded in N_4 (16.84).which was on par with N_2 (17.29).

There was significant difference observed on diameter of the fruit with respect to interaction effect between planting dates and FYM levels. Maximum fruit diameter was recorded in D_1N_1 (19.67). Minimum fruit diameter was recorded in D_5N_4 (16.4) and D_3N_4 (16.4).

4.4.4 Flesh thickness (cm)

The data on flesh thickness is presented in Table 22. Different planting dates and different FYM levels cause significant influence on flesh thickness.

The flesh thickness was significantly influenced by different planting dates. It was highest in D_1 (15.85) which were on par with D_2 (15.49). It was lowest in D_5 (14.24) and which was on par with D_4 (14.64).

Maximum flesh thickness was noticed in N_1 (15.83) and it was significantly higher than others. N_4 (14.47) recorded minimum flesh thickness value which was significantly lower than other FYM levels.

The interaction effect between the different planting dates and FYM levels did not show any significant variation in flesh thickness.

4.45 Rind thickness (cm)

Table 24. Effect of date of planting and levels of FYM on fruit girth (cm)

	N_1	N_2	N_3	N_4	Mean
D_1	60.83	53.37	55.33	52.63	55.54
D_2	59.50	52.70	52.87	53.47	54.63
D_3	53.70	52.97	53.80	50.73	52.80
D_4	52.53	52.53	52.30	50.90	52.07
D_5	51.73	51.97	51.73	50.70	51.53
Mean	55.66	52.71	53.21	51.69	

	D	N	DN
F	10.798**	12.365**	2.855*
CD	1.697	1.385	3.09
SE	0.5203	0.4797	1.070

**Significant at 1 per cent level

* Significant at 5 per cent level

Table 25. Effect of date of planting and levels of FYM on seed fruit $^{-1}$

	N_1	N_2	N_3	N_4	Mean
D_1	377.80	336.70	333.93	346.13	348.64
D_2	317.13	303.88	326.79	324.23	318.01
D_3	338.91	270.51	318.32	312.40	310.03
D_4	313.58	322.06	302.46	338.43	319.13
D_5	300.33	321.87	310.03	331.33	315.89
Mean	329.55	311.00	318.31	330.51	

	D	N	DN
F	3.809	1.038	0.773
CD	NS	NS	NS
SE	7.744	9.195	7.963

NS - Non significant

The different dates of planting, FYM levels and their interaction could not significantly influence the fruit rind thickness. (Table 23).

4.4.6 Fruit girth (cm)

The different dates of planting, FYM levels and their interaction could significantly influence the fruit girth. (Table 24).

The highest value was recorded by D_1 (55.54) and this was on par with D_2 (54.63). The lowest value was recorded by D_5 (51.53) and it was on par with D_4 (52.07) and D_3 (52.80).

The maximum value was recorded by N_1 (55.66) and this was significantly superior to other FYM levels. The minimum value was recorded by N_4 (51.68) and it was on par with N_2 (52.71).

D_1N_1 (60.83) recorded highest value and lowest value was recorded by D_5N_4 (50.70).

4.4.7 Seeds fruit $^{-1}$

The different planting dates, different FYM levels and their interaction did not significantly influence the seeds fruit^{-1}. (Table 25).

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4.4.8 100 seed weight (gm)

The different dates of planting, different FYM levels and their interaction could not significantly influence 100 seed weight. (Table 26).

4.5 QUALITY ATTRIBUTES

Table 26. Effect of date of planting and levels of FYM on 100 seed weight (gm)

	N_1	N_2	N_3	N_4	Mean
D_1	3.94	3.51	3.48	3.61	3.63
D_2	3.30	3.17	3.40	3.38	3.31
D_3	3.53	2.82	3.32	3.25	3.23
D_4	3.27	3.35	3.15	3.53	3.32
D_5	3.13	3.35	3.23	3.45	3.29
Mean	3.43	3.24	3.32	3.44	

	D	N	DN
F	3.809	1.038	0.773
CD	NS	NS	NS
SE	0.081	0.096	0.083

NS - Non significant

Table 27. Effect of date of planting and levels of FYM on total soluble solids

	N_1	N_2	N_3	N_4	Mean
D_1	10.82	9.65	9.57	9.92	9.99
D_2	9.08	8.70	9.36	9.29	9.11
D_3	9.71	8.37	9.12	8.95	9.04
D_4	8.98	9.23	8.66	9.69	9.14
D_5	8.60	9.22	8.88	9.49	9.05
Mean	9.44	9.03	9.12	9.47	

	D	N	DN
F	2.807	0.741	0.616
CD	NS	NS	NS
SE	0.242	0.257	0.223

NS - Non significant

4.5.1 Total soluble solids

The data presented in Table 27 reveal that either the different planting dates, FYM levels or their interaction could not significantly vary the total soluble solids of fruits.

4.5.2 Total sugar

Total sugar calculated and is presented in Table 28.

Planting dates exerted a considerable influence on total sugar content. It was maximum in D_1 (6.17) which were on par with D_2 (5.55). Minimum value was recorded in D_5 (5.05) which were on par with all other dates of planting except D_1.

Different FYM levels did not influence significantly on total sugar content. Different planting dates and FYM levels did not significantly interact with each other in the case of total sugar content.

4.5.3 Reducing sugar

Either different planting dates, FYM level or their interaction did not show any significant influence on reducing sugar (Table 29).

4.5.4 Non-Reducing sugar

The effect of different planting dates varied significantly in non-reducing sugar content. There was no significant difference observed on non-reducing content of the fruit with respect to FYM levels and their interaction (Table 30).

Maximum non-reducing content of the fruit was recorded in October 15th planting which was significantly superior to other planting dates. Minimum value

Table 28. Effect of date of planting and levels of FYM on total sugar (%)

	N_1	N_2	N_3	N_4	Mean
D_1	6.55	5.60	6.40	6.13	6.17
D_2	5.89	6.04	5.26	5.01	5.55
D_3	5.75	5.83	5.34	4.52	5.36
D_4	5.12	6.11	4.76	5.16	5.29
D_5	5.83	4.96	4.59	4.83	5.05
Mean	5.83	5.71	5.27	5.13	

	D	N	DN
F	4.709*	2.207	0.808
CD	0.6359	NS	NS
SE	0.1949	0.2271	0.507

* Significant at 5 per cent level

NS - Non significant

Table 29. Effect of date of planting and levels of FYM on reducing sugar (%)

	N_1	N_2	N_3	N_4	Mean
D_1	2.87	2.56	2.54	2.63	2.65
D_2	2.74	2.60	2.80	2.56	2.67
D_3	2.90	2.31	2.72	2.67	2.65
D_4	2.68	2.45	2.30	2.57	2.50
D_5	2.53	2.50	2.65	2.67	2.59
Mean	2.75	2.48	2.60	2.62	

	D	N	DN
F	1.690	2.109	0.685
CD	NS	NS	NS
SE	0.054	0.074	0.064

NS - Non significant

Table 30. Effect of date of planting and levels of FYM on non reducing sugar (%)

	N_1	N_2	N_3	N_4	Mean
D_1	3.66	3.03	3.85	3.49	3.51
D_2	3.15	3.43	2.45	2.44	2.87
D_3	2.84	3.51	2.60	1.94	2.70
D_4	2.43	3.62	2.45	2.57	2.77
D_5	3.29	2.45	1.92	2.15	2.45
Mean	3.08	3.21	2.66	2.50	

	D	N	DN
F	4.671*	1.856	0.791
CD	0.594	NS	NS
SE	0.182	0.248	0.5546

* Significant at 5 per cent level

NS - Non significant

Table 31. Effect of date of planting and levels of FYM on iron content (mg/100gm)

	N_1	N_2	N_3	N_4	Mean
D_1	5.29	4.81	4.77	4.61	4.87
D_2	4.56	4.34	4.66	4.80	4.59
D_3	4.84	3.86	4.54	4.46	4.42
D_4	4.47	4.60	4.32	4.83	4.55
D_5	4.22	4.53	4.35	4.36	4.37
Mean	4.68	4.42	4.53	4.61	

	D	N	DN
F	3.5083	0.7618	0.940
CD	NS	NS	NS
SE	0.104	0.125	0.109

NS - Non significant

Table 32. Effect of date of planting and levels of FYM on organoleptic test

	N_1	N_2	N_3	N_4	Mean
D_1	3.48	3.43	3.07	3.18	3.29
D_2	2.92	2.79	3.01	3.31	3.01
D_3	3.45	3.02	3.26	3.21	3.23
D_4	3.22	3.29	3.11	3.78	3.35
D_5	3.43	3.63	3.52	3.71	3.57
Mean	3.30	3.23	3.19	3.44	

	D	N	DN
F	0.787	1.33	0.935
CD	NS	NS	NS
SE	0.229	0.093	0.081

NS - Non significant

Table 33. Effect of date of planting and levels of FYM on nitrogen uptake (kg/ha)

	N_1	N_2	N_3	N_4	Mean
D_1	28.73	26.90	21.72	21.69	24.76
D_2	27.64	26.17	23.67	20.73	24.55
D_3	25.73	22.56	17.52	15.97	20.45
D_4	22.87	20.91	18.74	18.04	20.14
D_5	17.56	17.48	14.14	14.41	15.90
Mean	24.50	22.80	19.16	18.17	

	D	N	DN
F	35.453**	47.164**	1.600
CD	2.004	1.258	NS
SE	0.6145	0.4355	0.3772

**Significant at 1 per cent level

NS - Non significant

was recorded in December 15th planting which was on par with other planting dates except October 15th.

4.5.5 Iron content

The iron content of fruits is presented in Table 31.

Either different planting dates, FYM levels or their interaction did not show any significant influence on iron Content of the fruit.

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4.5.6 Organoleptic test (score: 1 to 5)

The data on organoleptic test is presented in Table 32.

The different planting dates, FYM levels and their interaction could not significantly influence the organoleptic characters of fruit.

4.6PLANT ANALYSIS

4.6.1 Nitrogen uptake (kgha^{-1})

The data presented in Table 33 reveals that the different planting dates, FYM levels could significantly vary the nitrogen uptake in plants. But interaction could not significantly vary the nitrogen uptake in plants.

The highest value was recorded by D_1 (24.76) and it was on par with D_2 (24.55). The lowest value was recorded by D_5 (15.9) and it was significantly lower than other planting dates.

Table 34. Effect of date of planting and levels of FYM on phosphorus uptake (kg/ha)

	N_1	N_2	N_3	N_4	Mean
D_1	5.34	4.33	3.67	3.33	4.17
D_2	5.17	4.67	3.67	3.33	4.21
D_3	4.33	3.33	3.83	3.33	3.71
D_4	4.67	4.33	3.33	3.17	3.88
D_5	3.50	3.33	2.83	2.67	3.08
Mean	4.60	4.00	3.47	3.17	

	D	N	DN
F	4.985*	35.939**	2.046
CD	0.666	0.304	NS
SE	0.204	0.105	0.091

*Significant at 5 per cent level

** Significant at 1 per cent level

NS- Non significant

Table 35. Effect of date of planting and levels of FYM on potassium uptake (kg/ha)

	N_1	N_2	N_3	N_4	Mean
D_1	32.26	29.80	23.23	23.91	27.30
D_2	31.62	29.62	23.36	23.34	26.99
D_3	29.15	26.59	20.28	16.91	23.23
D_4	25.91	24.25	21.23	20.41	22.95
D_5	19.54	19.13	15.42	16.39	17.62
Mean	27.70	25.88	20.71	20.19	

	D	N	DN
F	21.943**	40.984**	1.517
CD	2.729	1.517	NS
SE	0.836	0.5254	

**Significant at 1 per cent level

NS - Non significant

The maximum value was recorded by N_1 (24.5) and this was significantly superior to other FYM levels. The minimum value was recorded by N_4 (18.17) and it was on par with N_3 (19.16).

4.6.2 Phosphorus uptake (kgha^{-1})

The data presented in Table 34 reveals that the different planting dates and FYM levels could significantly vary the phosphorus uptake in plants. But interaction could not significantly vary the phosphorus uptake in plants.

The highest value was recorded by D_2 (4.21) and this was on par with other planting dates except D_5. The lowest value was recorded by D_5 (3.08) and it was on par with D_3 (3.71).

The maximum value was recorded by N_1 (4.6) and this was significantly superior to other FYM levels. The minimum value was recorded by N_4 (3.17) and it was on par with N_3 (3.47).

4.6.3 Potassium uptake (kgha^{-1})

The data presented in Table 35 reveals that the different planting dates and FYM levels could significantly vary the potassium uptake in plants. But interaction could not significantly vary the potassium uptake in plants.

The highest value was recorded by D_1 (27.3) and this was on par with D_2 (26.99). The lowest value was recorded by D_5 (17.62) and it was significantly lower than other planting dates.

The maximum value was recorded by N_1 (27.7) and this was significantly superior to other FYM levels. The minimum value was recorded by N_4 (20.19) and it was on par with N_3 (20.71).

Table 36. Effect of date of planting and levels of FYM on available nitrogen (kg/ha)

	N_1	N_2	N_3	N_4	Mean
D_1	372.14	351.23	309.42	284.32	329.28
D_2	372.14	342.86	317.78	296.87	332.41
D_3	367.96	347.04	317.78	284.33	329.28
D_4	347.05	321.96	305.24	292.69	316.74
D_5	363.78	313.86	296.87	271.78	311.58
Mean	364.61	335.39	309.42	286.00	

	D	N	DN
F	2.080	108.651**	1.377
CD	NS	9.375	NS
SE	6.331	3.247	2.812

**Significant at 1 per cent level

NS - Non significant

Table 37. Effect of date of planting and levels of FYM on available phosphorus (kg/ha)

	N_1	N_2	N_3	N_4	Mean
D_1	77.33	72.67	68.49	63.72	70.55
D_2	77.15	72.60	68.26	62.40	70.10
D_3	79.42	71.59	67.90	63.50	70.60
D_4	77.66	73.06	69.52	64.38	71.15
D_5	77.58	73.13	69.44	62.52	70.67
Mean	77.83	72.61	68.72	63.31	

	D	N	DN
F	0.490	342.20**	1.135
CD	NS	0.9579	NS
SE	0.531	0.332	0.287

**Significant at 1 per cent level

NS - Non significant

4.7 SOIL ANALYSIS

4.7.1Available nitrogen content in soil (kgha^{-1})

The data on available nitrogen content of soil after the harvest of crop is given in Table 36.

The different planting dates and interaction effect had no significant effect on available nitrogen content in the soil. FYM levels significantly influenced the available nitrogen content of the soil.

Among FYM levels maximum nitrogen content was recorded by N_1 (5 kg FYM plant^{-1}) and was significantly superior to all other treatments. POP recommendation was inferior to all treatments.

4.7.2 Available phosphorus content in soil (kgha^{-1})

Table 37 shows the significant influence of FYM levels on available phosphorus content of the soil.

Both planting dates and interaction effects of planting dates and FYM levels had no significant effect on available phosphorus content of soil.

Various FYM levels significantly influenced the available phosphorus content of soil. Application of 5kg FYM plant^{-1} registered the highest value of 77.83 and was significantly superior to all other treatment. POP recommendation registered the lowest value of 63.31.

4.7.3 Available potassium content in the soil (kgha^{-1})

Table 38. Effect of date of planting and levels of FYM on available potassium (kg/ha)

	N_1	N_2	N_3	N_4	Mean
D_1	168.50	148.00	131.50	115.00	140.75
D_2	173.67	155.33	126.00	102.17	139.29
D_3	177.33	146.16	120.50	98.33	135.58
D_4	167.00	153.50	131.50	109.50	140.38
D_5	159.17	133.50	117.00	99.33	127.25
Mean	169.13	147.30	125.30	104.87	

	D	N	DN
F	3.586	176.770**	1.350
CD	NS	6.024	NS
SE	2.977	2.0867	4.664

**Significant at 1 per cent level

NS - Non significant

Table 39. Effect of date of planting and levels of FYM on gross return (Rs) of watermelon

	N_1	N_2	N_3	N_4	Mean
D_1	623758.33	373573.96	467098.04	385816.67	462561.75
D_2	486692.50	361517.33	292206.13	335031.67	368861.91
D_3	378283.26	292427.68	389989.25	277707.50	334601.93
D_4	355975.95	320515.42	290749.67	276045.00	310821.51
D_5	304836.46	280205.33	244472.43	213616.67	260782.73
Mean	429909.30	325647.95	336903.11	297643.50	

	D	N	DN
F	12**	37.31**	5.67**
CD	70961.96	27110.263	60620.39
SE	21759.62	9387.78	20991.718

**Significant at 1 per cent level

The data given in Table 38 clearly showed the significant influence of FYM levels on available potassium content in the soil.

Available potassium content in the soil was significantly influenced by different FYM levels. Different planting dates and DXN interaction had no significant effect on available potassium content in the soil.

Treatment N_1 (5 kg FYM plant^{-1}) recorded the highest value and was superior to all other treatments. All treatments were significantly superior to N_4 (POP recommendation).

4.8 Economics of cultivation

4.8.1 Gross Return

The Gross Return is presented in Table 39. The different planting dates and FYM levels had significant influence on gross return of watermelon. Interaction effect had significant influence on gross return of watermelon.

Highest gross return (462561.75) was obtained for October 15th planting and was significantly superior to other planting dates. Lowest gross return (260782.72) was obtained for December 15th planting.

Highest gross return (429909.31) was obtained for N_1 and was significantly superior to other FYM levels. Lowest gross return (297643.5) was obtained for N_4. Highest gross return (623758.33) was obtained for D_1N_1. Lowest gross return (213616.66) was obtained for D_5N_4.

4.8.2 Net Return

Table 40. Effect of date of planting and levels of FYM on net return (Rs) of watermelon

	N_1	N_2	N_3	N_4	Mean
D_1	340008.30	102668.96	205223.04	128158.67	194014.75
D_2	206792.50	93517.33	34128.63	79998.67	103609.28
D_3	109985.80	29100.18	138036.75	29674.50	76699.30
D_4	97023.46	69140.42	48124.67	37934.50	63055.76
D_5	44133.97	26800.33	1269.93	3208.66	18853.22
Mean	159588.80	64245.44	85356.60	55795.00	

	D	N	DN
F	12**	31.91**	7.02**
CD	61303.172	24142.623	53984.545
SE	18797.87	8360.14	18693.84

**Significant at 1 per cent level

Table 41. Effect of date of planting and levels of FYM on B:C ratio of watermelon

	N_1	N_2	N_3	N_4	Mean
D_1	2.20	1.38	1.78	1.50	1.71
D_2	1.74	1.35	1.13	1.31	1.38
D_3	1.41	1.11	1.55	1.12	1.29
D_4	1.37	1.28	1.20	1.16	1.25
D_5	1.17	1.10	1.01	1.02	1.07
Mean	1.58	1.24	1.33	1.22	

	D	N	DN
F	12**	30.76**	7.30**
CD	0.2205	0.08508	0.19024
SE	0.0681	0.0295	0.0659

**Significant at 1 per cent level

The net return is given in Table 40.

Different planting dates recorded significant variation in net return. Maximum net return (194014.75) was noticed in October 15th planting (D_1). D_5 (18853.22) recorded minimum net return.

The effect of different FYM levels varied significantly in net return. Maximum net return was recorded in N_1 (159588.81) which were significantly superior to other FYM levels. Minimum net return was recorded in N_4 (55795.00) which were on par with N_2 (64245.44).

There was significant difference observed on net return with respect to interaction effect between planting dates and FYM levels. Maximum net return was recorded in D_1N_1 (340008.33). Minimum net return was recorded in D_5N_3 (1269.93)

4.8.3 Benefit: Cost ratio

The different dates of planting, FYM levels and their interaction could significantly influence the B: C ratio of watermelon. (Table 41).

The highest value was recorded by D_1 (1.72) .The lowest value was recorded by D_5 (1.07).

The maximum value was recorded by N_1 (1.58) and this was significantly superior to other FYM levels. The minimum value was recorded by N_4 (1.22) and it was on par with N_2 (1.24). D_1N_1 (2.19) recorded highest value and lowest value was recorded by D_5N_3 (1.00).

Discussion

5. DISCUSSION

An experiment was conducted to find out a suitable date of planting and the effect of different doses of FYM on the growth, yield and economics for the cultivation of organic water melon. The results obtained are discussed below.

5.1 EFFECT OF DATE OF PLANTING, LEVELS OF NUTRIENTS AND THEIR INTERACTION ON GROWTH, YIELD ATTRIBUTING CHARACTERS AND YIELD OF WATERMELON

5.1.1 Growth Characters

The branches plant^{-1} responded positively to the different dates of planting and levels of nutrients and their interaction and main vine length responded positively to different dates of planting and levels of nutrients. Different dates of planting and nutrient levels significantly varied number of branches per plant and main vine length towards the later stages of plant growth.

Among the different dates of planting October 15th planting recorded significantly higher number of branches (4.25) and it was significantly superior to December 15th planting (3.08) at harvest.

Maximum vine length was reported in October 15th planting (386.25) and it was on par with November 1st planting (380.83). Lowest vine length was noticed in December 15th planting (249.42).

The number of branches per plant and vine length was significantly higher during October 15th to November 1st. This might be due to the warm and humid weather condition which is favorable for vegetative growth. Similar findings of increased growth parameters due to warm and humid conditions prevailed during growth period have been reported by Sharma et al., (2005). Similar findings of increased vine length in September planting than later planting had been reported by (Zulu 2010). The number of branches per plant and vine length were lower for later planting date (December 15th) and this might be due to high humidity which impeded the growth and development of

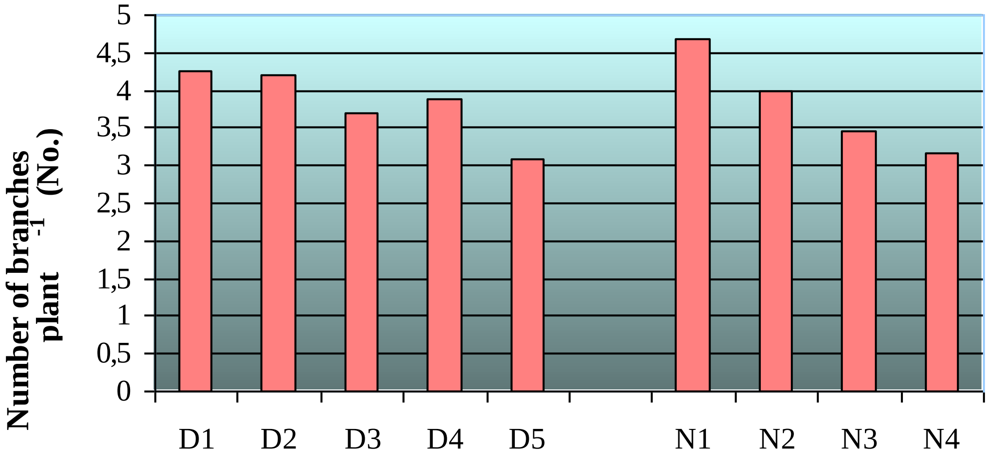

Fig .3. Effect of date of planting and levels of FYM on branches plant $^{-1}$ at harvest

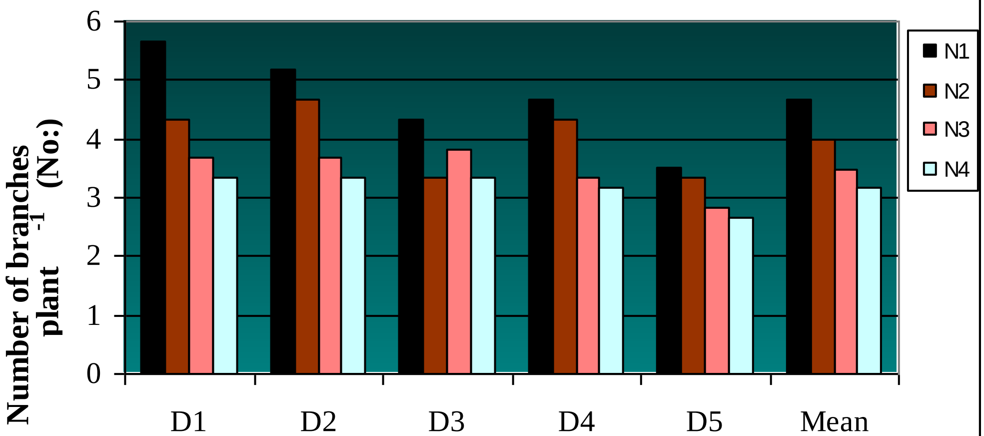

Fig.3a.Effect of dates of planting and levels of FYM on number of branches plant $^{-1}$ at harvest

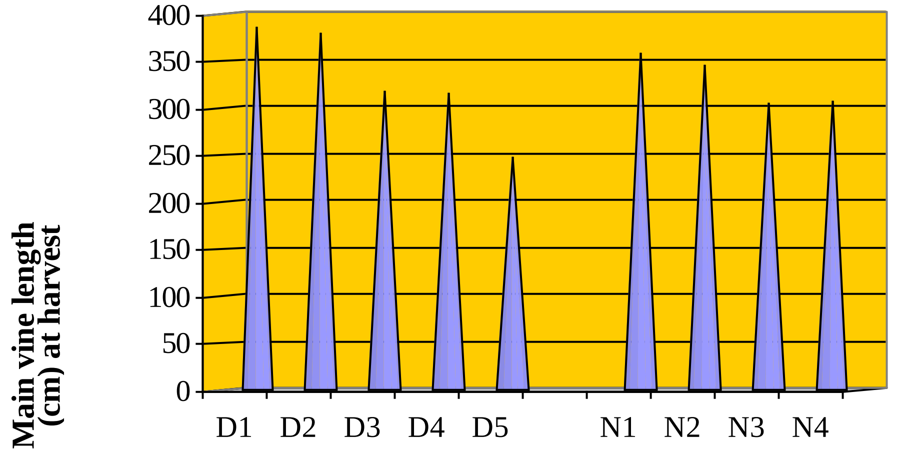

Fig .4. Effect of date of planting and levels of FYM on main vine length

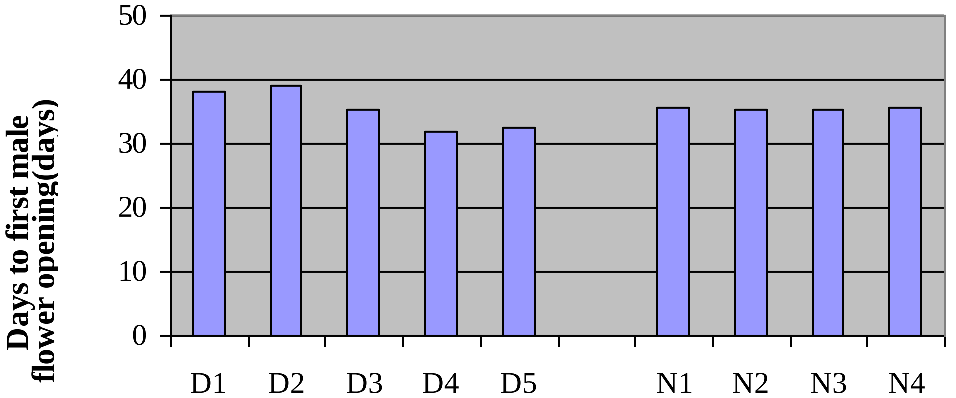

Fig .5. Effect of date of planting and levels of FYM on days to first male flower opening

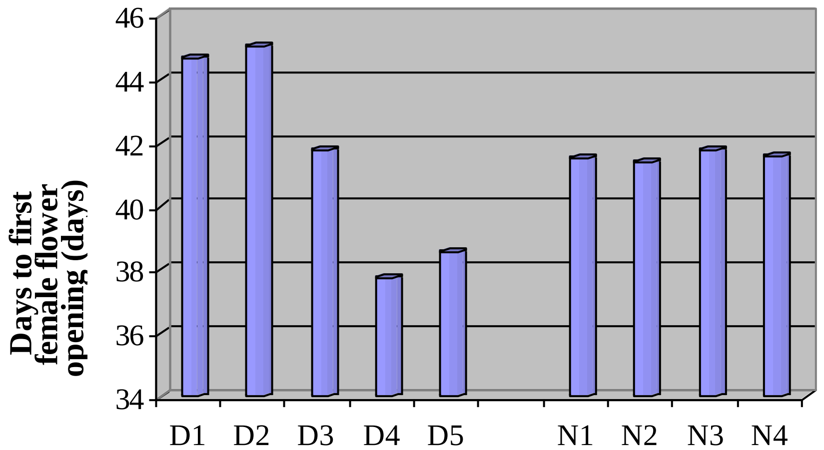

Fig .6. Effect of date of planting and levels of FYM on days to first female flower opening

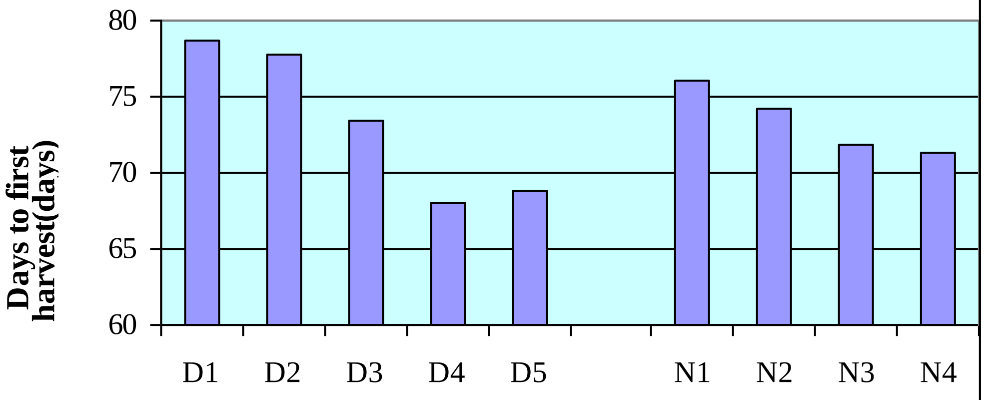

Fig .7. Effect of date of planting and levels of FYM on days to first harvest

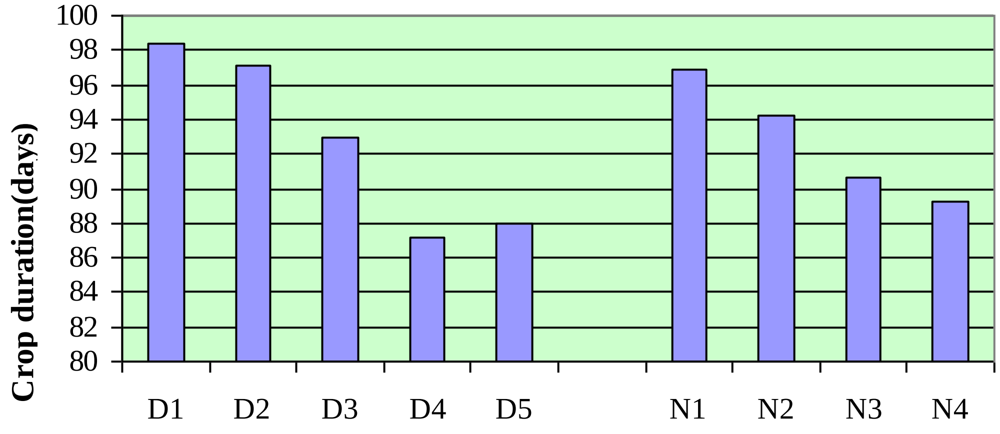

Fig .8. Effect of date of planting and levels of FYM on crop duration

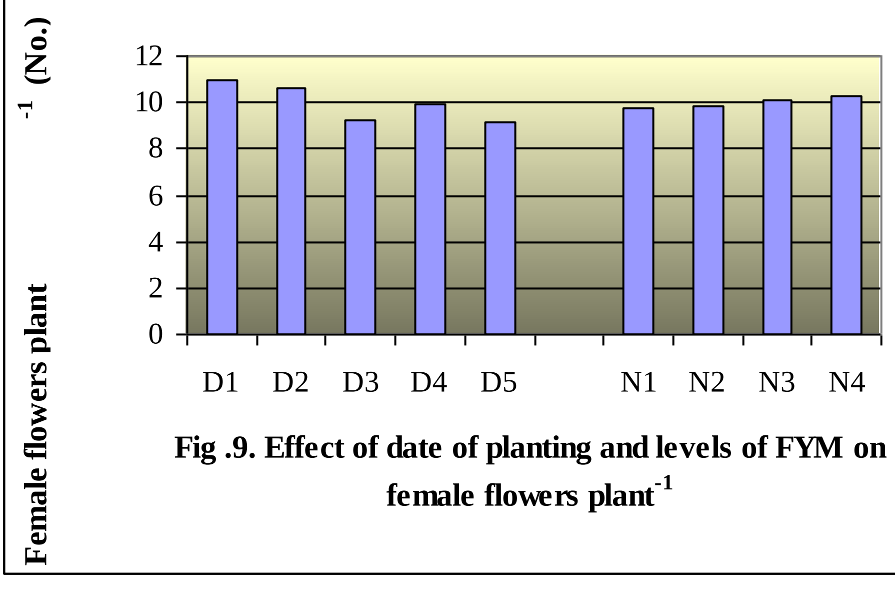

Fig .9. Effect of date of planting and levels of FYM on female flowers plant^{-1}

water melon. This is in conformity with the findings of Ogbonna and Obi (2007). The extensive growth of vine in October sowing might be due to warm humid condition favorable for vegetative growth. Similar increase in plant height due to rise in temperature have been reported by Heij (1981).

More number of branches were obtained at the highest nutrient level i.e. 5 kg FYM plant^{-1} (4.67) and the lowest by 2 kg FYM plant^{-1} (3.16). Maximum vine length was obtained with the highest nutrient level i.e. 5 kg FYM plant^{-1} (359.77) and it was on par with 4 kg FYM plant^{-1} 345.57 at harvest. The lowest by 3 kg FYM plant^{-1} (306.93) and it was on par with 2 kg FYM plant^{-1} (308.50).

The increased availability of nutrients through higher dose of FYM might have increased the nutrient uptake. The increased uptake of nitrogen might have contributed to rapid meristematic activity (Crowther, 1935) and the higher rate of metabolic activity coupled with rapid cell division brought about by phosphorus (Bear, 1965) and by increased growth of meristematic tissue (Tisdale and Nelson, 1985) might have led to increased vine length towards later stage.

5.1.2 **Yield Attributing Characters and Yield**

Later planting dates showed significant earliness in flowering and earlier planting showed delay in flowering. Similar findings of earliness in flowering for late planting have been reported by Farooq (1992).

December 15th planting took minimum days to first harvest and crop duration and it was on par with December 1st planting. October 15th took maximum days to first harvest and crop duration and it was on par with November 1st planting. The higher temperature experienced by the late planted crops (December 15th and 1st planting) towards the later period of growth might have reduced the days taken for first harvest and the total duration of the crop. Sharma (2005) also reported that the periods of phenophases such as sowing to the first male and first female flowers and sowing to first harvest and last harvest were significantly longer for earlier sowing than late sowing.

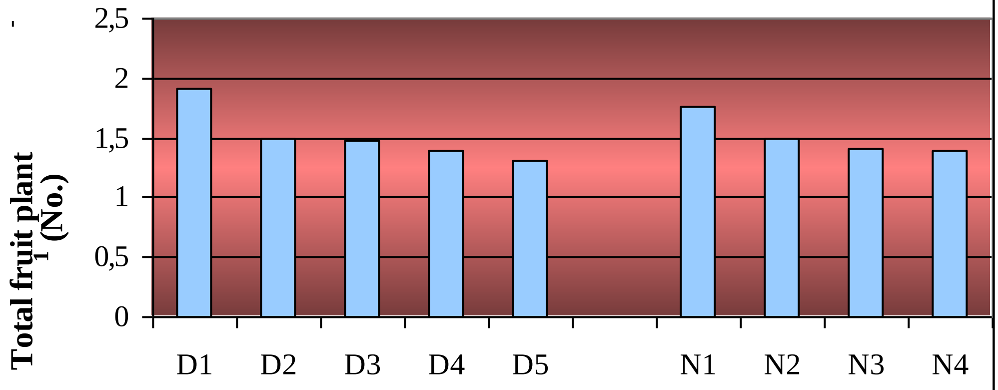

Fig .10. Effect of date of planting and levels of FYM on total fruit plant^{-1}

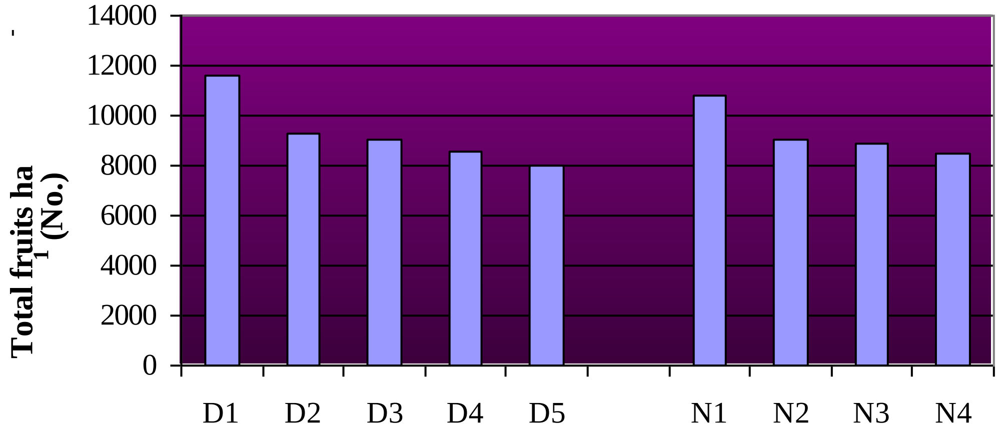

Fig .11. Effect of date of planting and levels of FYM on total fruit ha^{-1}

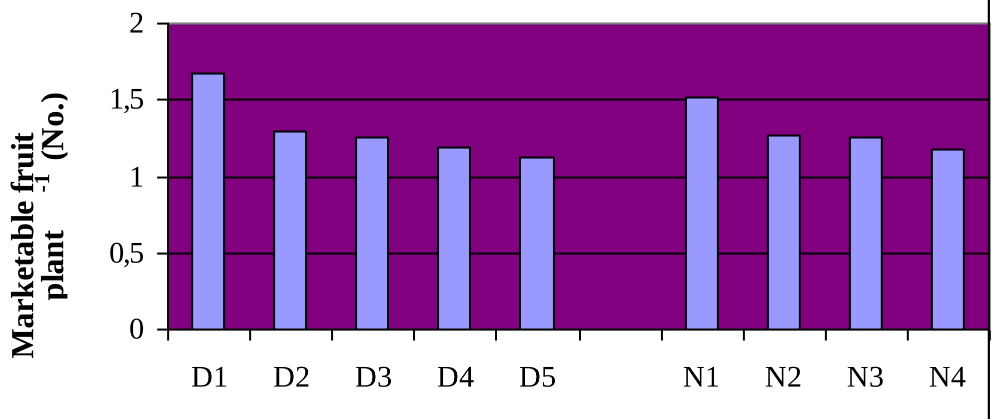

Fig .12. Effect of date of planting and levels of FYM on marketable fruit plant^{-1}

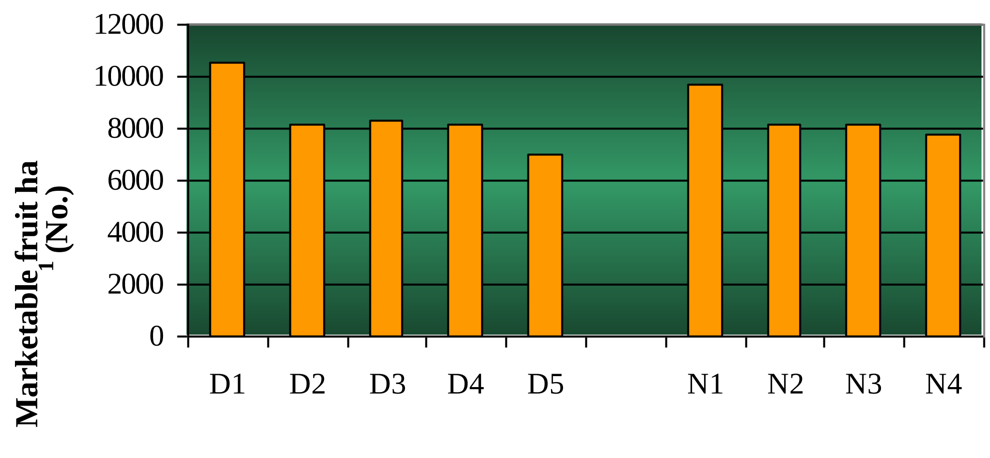

Fig .13. Effect of date of planting and levels of FYM on marketable fruit ha^{-1}

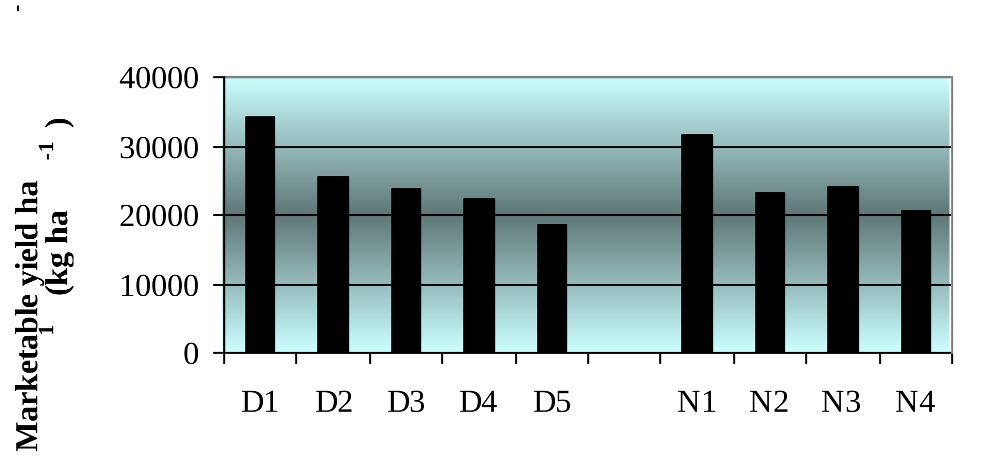

Fig .14. Effect of date of planting and levels of FYM on marketable yield ha^{-1}

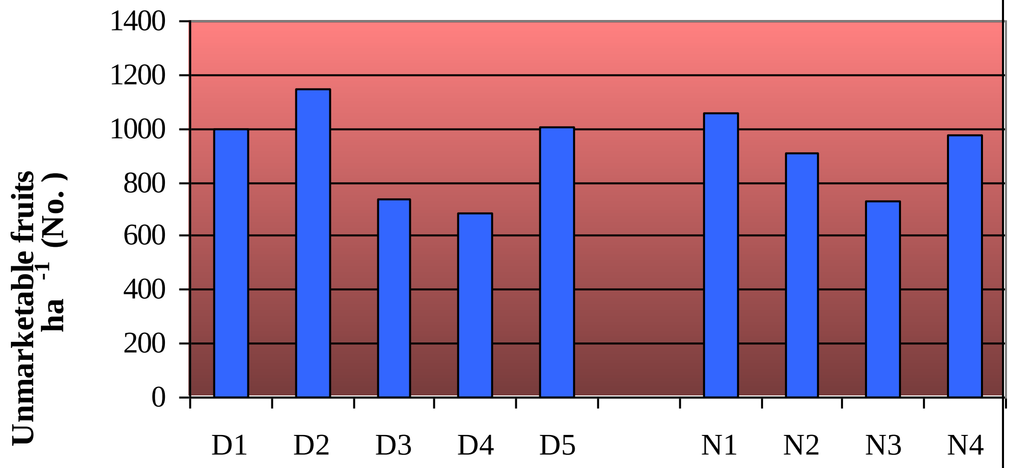

Fig .15. Effect of date of planting and levels of FYM on unmarketable fruit ha^{-1}

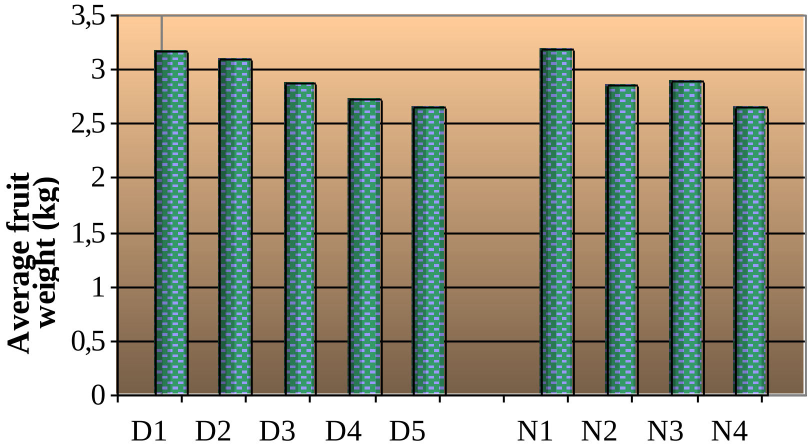

Fig .16. Effect of date of planting and levels of FYM on average fruit weight

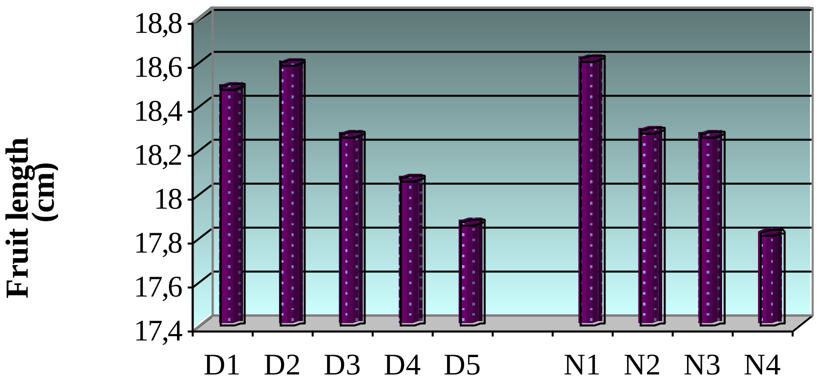

Fig .17. Effect of date of planting and levels of FYM on fruit length

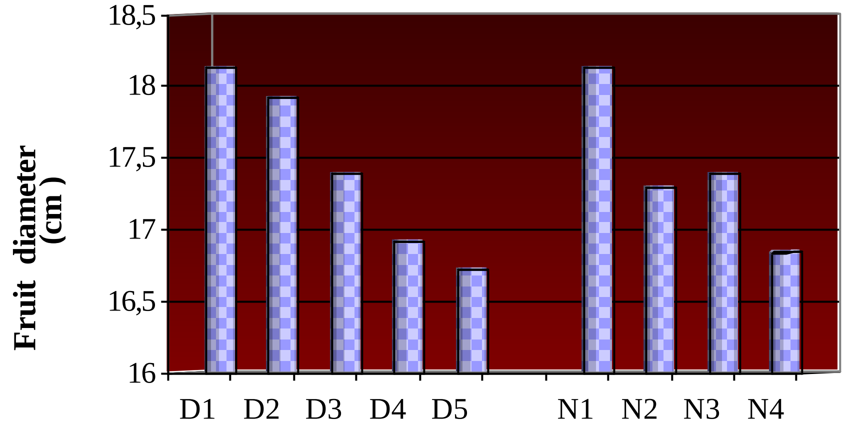

Fig .18. Effect of date of planting and levels of FYM on fruit diameter

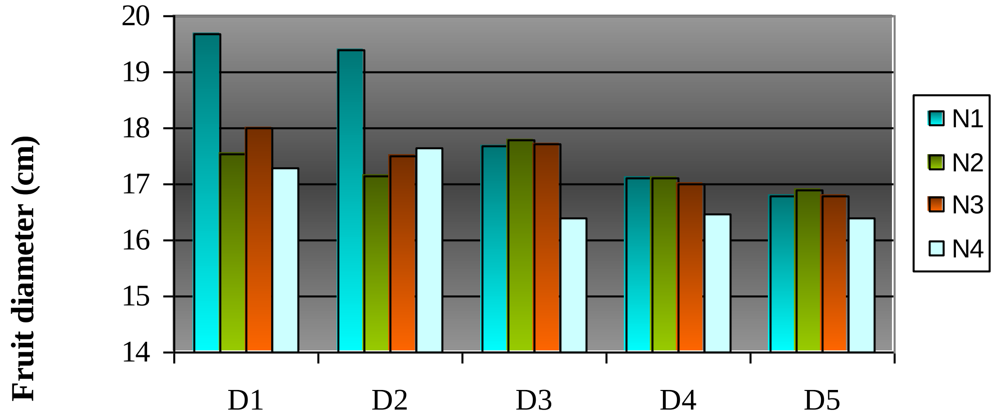

Fig .18a. Effect of date of planting and levels of FYM on average fruit diameter

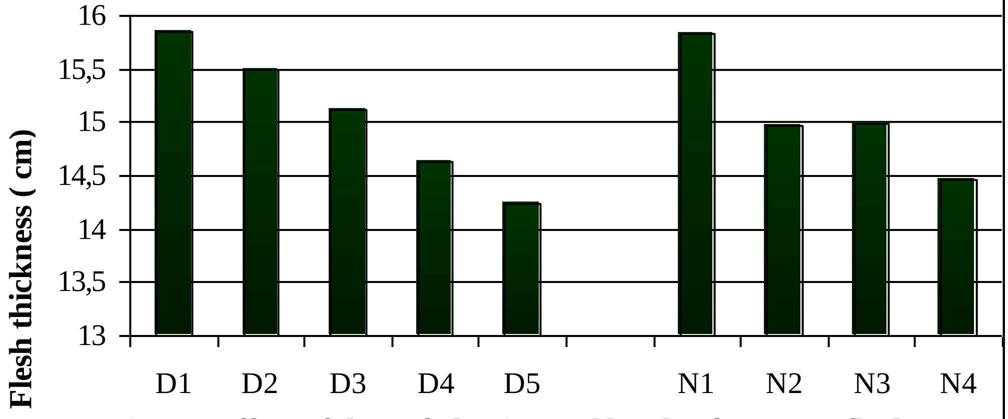

Fig .19. Effect of date of planting and levels of FYM on flesh thickness

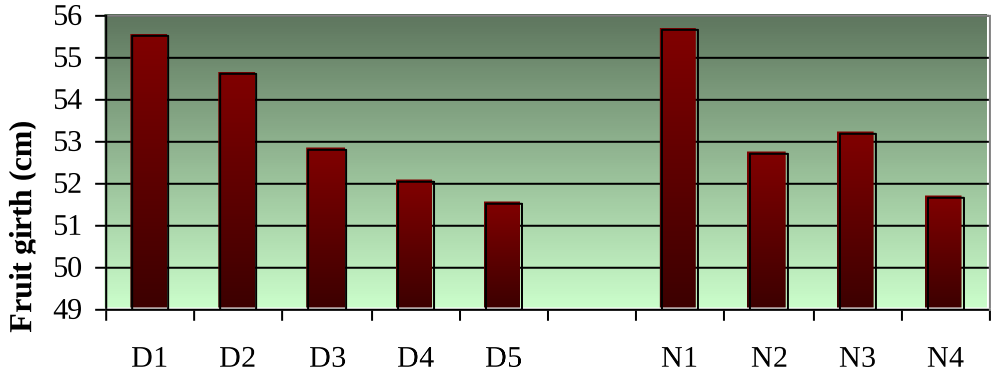

Fig .20. Effect of date of planting and levels of FYM on fruit girth

Application of nutrients as per the POP recommendation of Kerala Agricultural University (N4) noticed minimum number of days to first harvest and crop duration and it was on par with N3 (3 kg FYM plant^{-1}). N_1 (5 kg FYM plant^{-1} noticed maximum number of days to first harvest and crop duration and was significantly superior to other FYM levels. The higher availability of nutrients increased the meristematic activity of plants and increased the growth of crop which in turn increased the total duration of the crop.

The higher number of female flowers plant^{-1} was recorded by earlier dates of planting viz., October 15th (11) and November 1st planting (10.58). Delayed planting recorded significantly lower number of female flower plant^{-1}, 9.13 and 9.25 for December 15th and December 1st planting. Similar trend was noticed in the case of total fruits plant^{-1}, total fruits ha^{-1}, marketable fruit plant^{-1} and ha^{-1}, average fruit weight, fruit diameter, fruit girth and fruit length. The weather condition prevailed during the growth stage of earlier dates of planting are congenial for the growth and yield attributing characters of crops. Several workers reported that reproductive physiology is more sensitive to high temperature stress than vegetative growth. Temperature elevation from 25 to 35°C increased the male flowers of watermelon while very few flowers were produced at 40°C (Sedgely and Buttrose 1978, Barker and Allen 1993). The high temperature prevailed during reproductive stages of late plantings might be the reason for the reduced yield from these crops. Sedgely and Buttrose (1978) also reported similar findings. Baker and Reddy (2001) reported that high air temperatures in midsummer may reduce bee activity and pollination. This may affect the reproductive development or shorten the duration of the growing season. Whitaker and Davis (1962) also reported that the later planting dates were not suitable as low temperature reduced the plant fruiting and fruit set**.** Studies conducted at Kerala Agricultural University reported that inflorescent plant^{-1}, flowers cluster^{-1}, fruits cluster^{-1} and fruit set were maximum in October planting followed by November planting (KAU, 1987). Studies conducted at Kerala Agricultural University revealed that planting in the second fortnight of November gave significantly higher yield compared to other sowing dates (KAU (1993). Perusal of results in tables revealed that the highest number of female flowers plant^{-1}, total fruits plant^{-1}, total fruits ha^{-1}, marketable fruit plant^{-1} and ha^{-1}, average fruit weight, fruit diameter, fruit girth and fruit length were significantly influenced by the

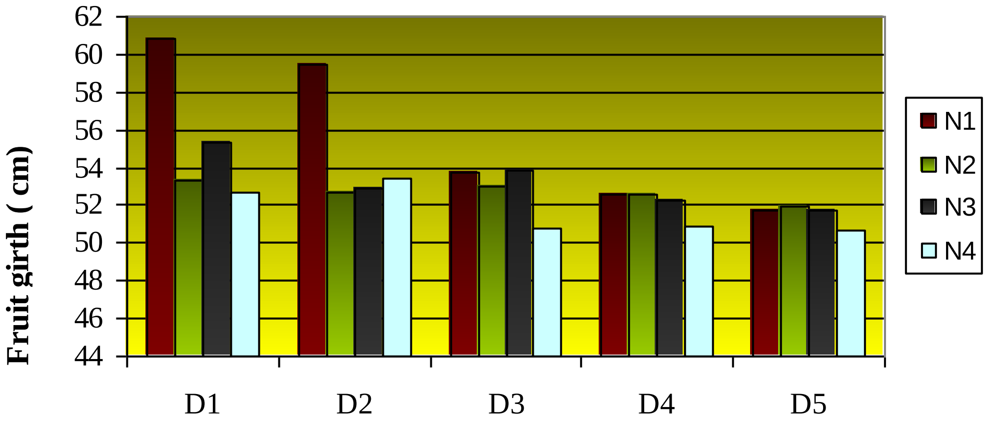

Fig .20a. Effect of date of planting and levels of FYM on fruit girth

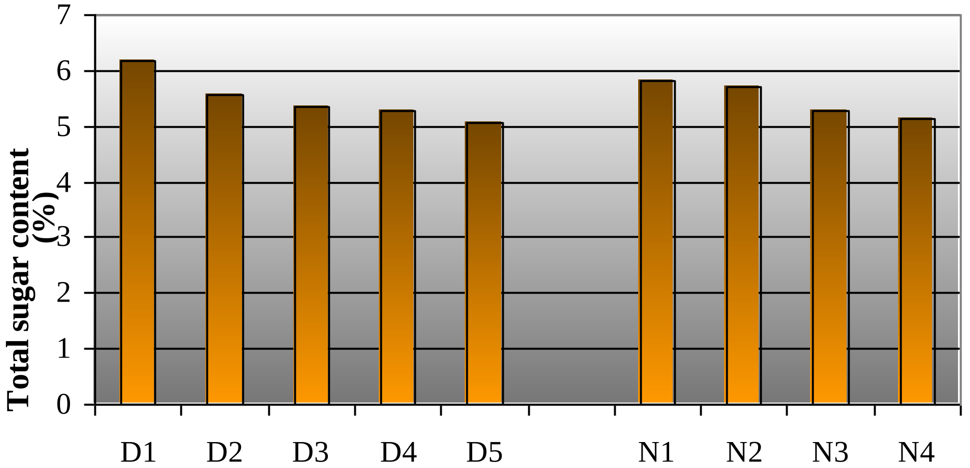

Fig .21. Effect of date of planting and levels of FYM on total sugar content

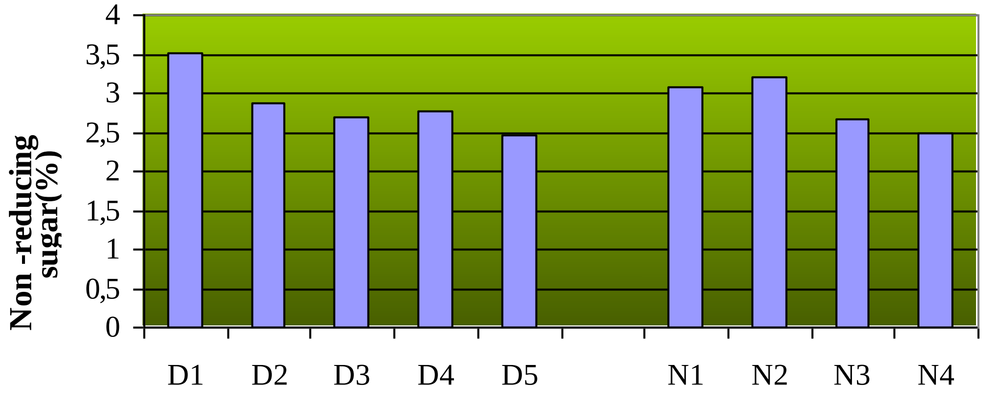

Fig .22. Effect of date of planting and levels of FYM on non reducing sugar

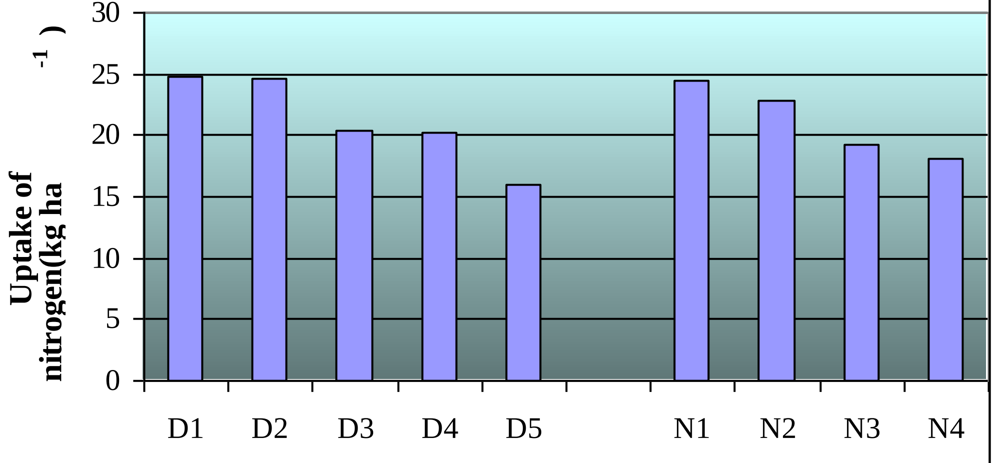

Fig .23. Effect of date of planting and levels of FYM on nitrogen uptake

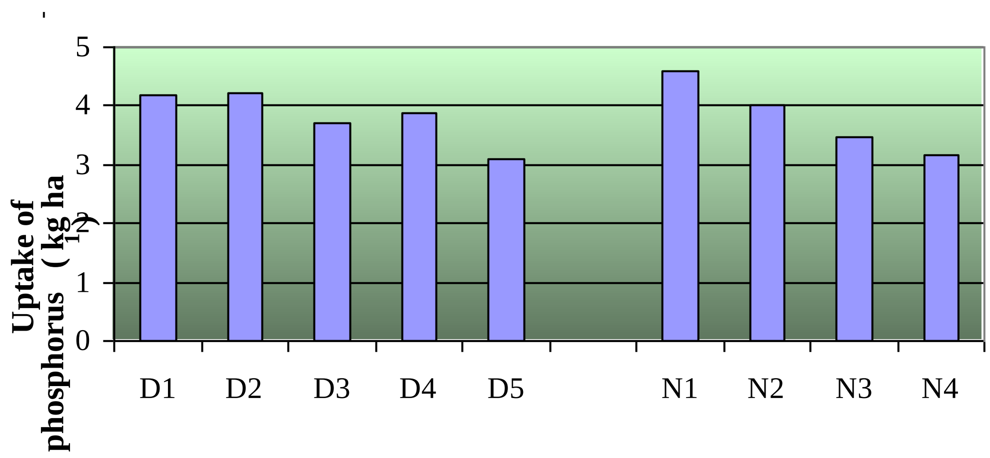

Fig .24. Effect of date of planting and levels of FYM on phosphorus uptake

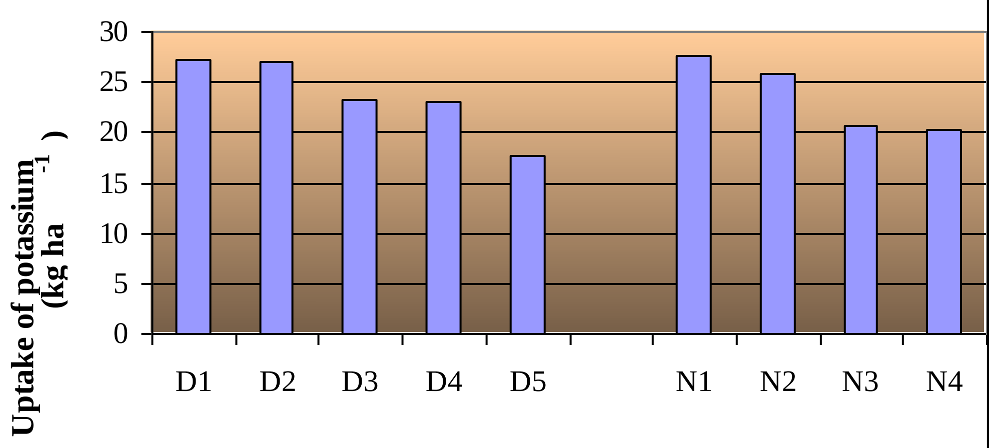

Fig .25. Effect of date of planting and levels of FYM on potassium uptake

different nutrient levels. The highest dose of organic manures (5kg FYM plant^{-1}) recorded the highest number of female flowers plant^{-1}, total fruits plant^{-1}, total fruits ha^{-1}, marketable fruit plant^{-1}, marketable fruit ha $^{-1}$, average fruit weight, fruit diameter, fruit girth and fruit length. The higher availability and uptake of nutrients might have enabled the plant to produce more number of flower buds which in turn increased the number of fruits. Similar increased fruit yield plant^{-1} due to improved vegetative growth, better availability of nutrients, greater synthesis of carbohydrates and their proper translocation were reported by Dar et al., 2009. The photosynthetic activity of the plant is modified by the nutritional status of the plant, since the nitrogen content in the plants increased with increasing levels of nutrients in the soil. The positive direct effect of growth and yield attributing characters due to increased dose of organic manure have resulted in significantly better, total fruits plant^{-1}, total fruits ha^{-1},marketable fruit plant^{-1} and ha^{-1}, average fruit weight and fruit length. Similar results of increased fruit yield plant^{-1}due to increased nutrient levels have been reported by Raj (1999) and Hedau et al., (2001).

5.2. EFFECT OF DATE OF PLANTING, LEVELS OF NUTRIENTS AND THEIR INTERACTION ON QUALITY ATTRIBUTES OF WATERMELON

Quality attributes like total sugar content and non-reducing content were significantly influenced by different planting dates. Total sugar content and non-reducing content were more on earlier dates of planting viz., October 15th and November 1st planting. Low total sugar content was recorded for later dates of planting (December 15th). Similar results of high total sugar content on earlier planting date on November 20th was reported by Desai and Patel (1984) on watermelon. Kurata (1970) also reported that climate significantly influenced the quality of watermelon fruits. There was decrease in total sugar content as the sowing dates proceeded towards summer.

5.3. EFFECT OF DATE OF PLANTING, LEVELS OF NUTRIENTS AND THEIR INTERACTION ON NUTRIENT UPTAKE OF WATERMELON

Nutrient uptake was significantly influenced by different dates of planting. Earlier dates of plantings (October 15th and November 1st planting) registered more nitrogen, phosphorus and potassium uptake than late plantings and the lowest nitrogen, phosphorus and potassium uptake were recorded by December 15th planting.

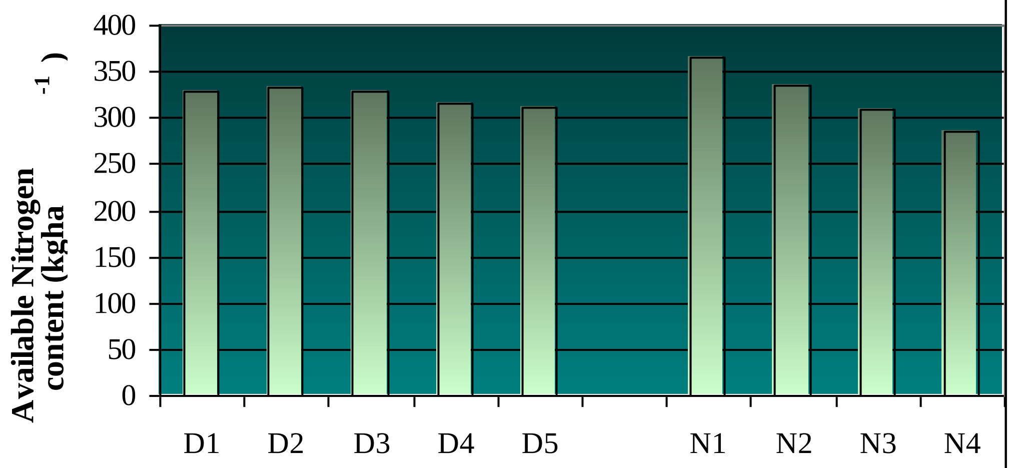

Fig .26. Effect of date of planting and levels of FYM on available nitrogen content in soil

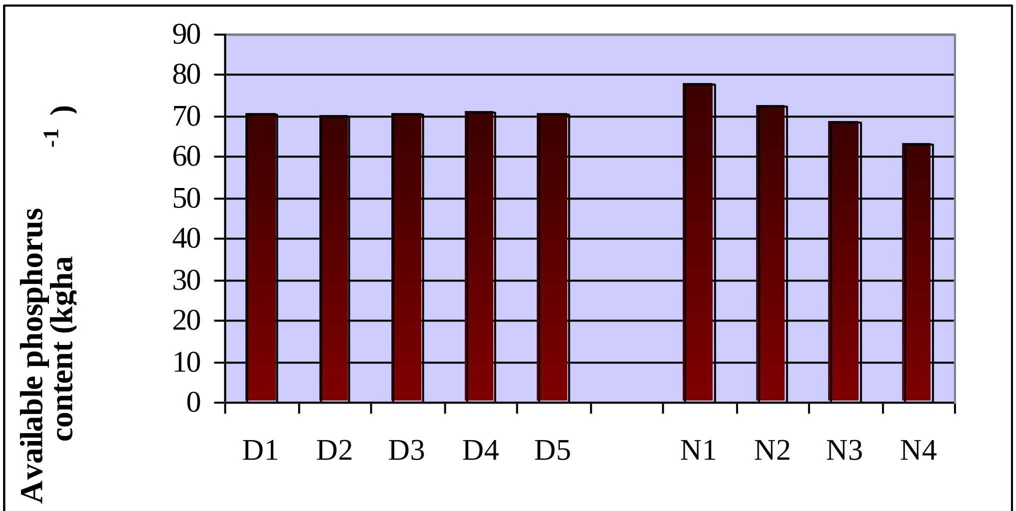

Fig .27. Effect of date of planting and levels of FYM on available phosphorus in soil

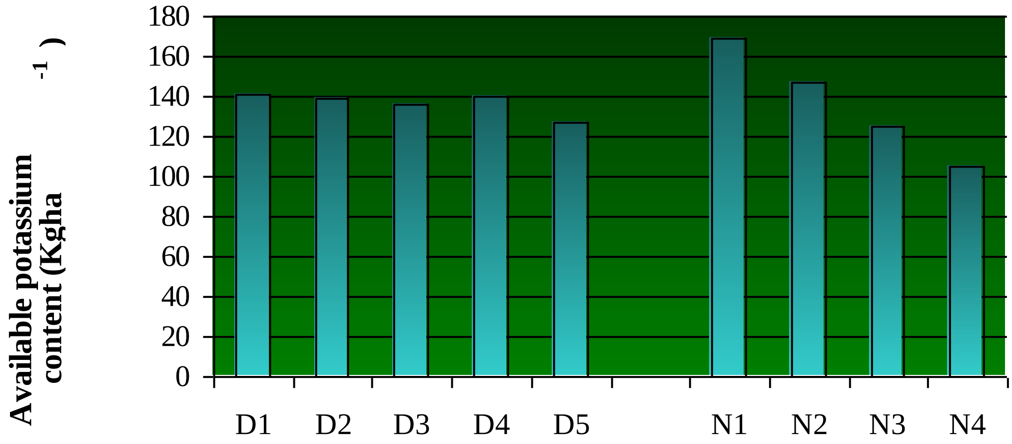

Fig .28. Effect of date of planting and levels of FYM on available potassium in soil

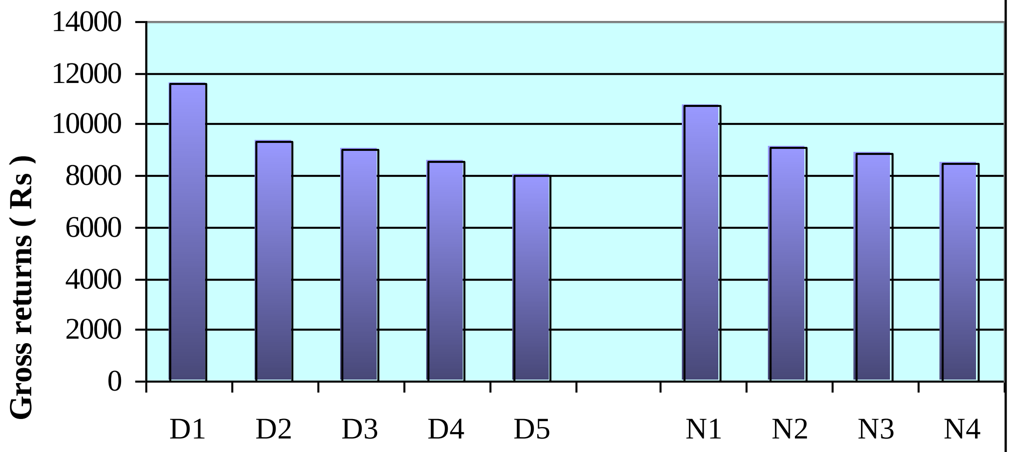

Fig .29. Effect of date of planting and levels of FYM on Gross returns

The higher growth attributing characters resulted in higher dry matter production for earlier planting might be the reason for the increased uptake of these nutrients.

Nitrogen, phosphorus and potassium uptake were significantly influenced by different FYM levels. The highest values of nitrogen, phosphorus and potassium uptake were recorded in plants treated with FYM @ 5kg $plant^{-1}$.

The increase in nutrient uptake due to the application of organic manures might be due to the fact that organic manures like FYM when applied to soil results in the breakdown of complex nitrogenous compounds by the action of micro organisms (slow mineralization) and its availability to the soil in the form of nitrate nitrogen (Rajeswari and Shakila, 2009). Increase in available P content of soil due to organic manure application may be due to the solubilization of native P through release of various organic acids (Sharma et al., 2009) which might be the reason for increased uptake. Similar results of increased nutrient uptake due to the application of higher organic manures were reported by Barani and Anburani (2004) and Raj (1999).

5.4. EFFECT OF DATE OF PLANTING, LEVELS OF NUTRIENTS AND THEIR INTERACTION ON AVAILABLE NUTRIENT STATUS OF WATERMELON

FYM levels had a significant influence on the available N, P, K content of the soil. The highest value for available N, P and K status of the soil was obtained for the treatment N_1 (5 kg FYM $plant^{-1}$). According to Prasad and Singh (1980) available N content of soil increased with the continuous use of FYM. Kanwar and Prihar (1982) also reported that continuous application of FYM increased the nitrogen content of soil. Srivastava (1985) also observed that FYM addition increased the total N and available P and K status in the soil. Dhanorkar et al., (1994) found that continuous use of FYM raised the available K content of soil by 1.3 to 5.4 folds over control. Addition of FYM improved the N, P and K status of soil (Bandgopadhyay and Puste, 2002). Negi et al (1981) reported an increase in the available K content of the soil in FYM applied plots compared to fertilizer applied plots. Havanagi and Mann (1970) reported that FYM application increased available P_2O_5 content of the soil. Available K increased slightly with the addition of FYM for a long time (Sharma et al., 1984).

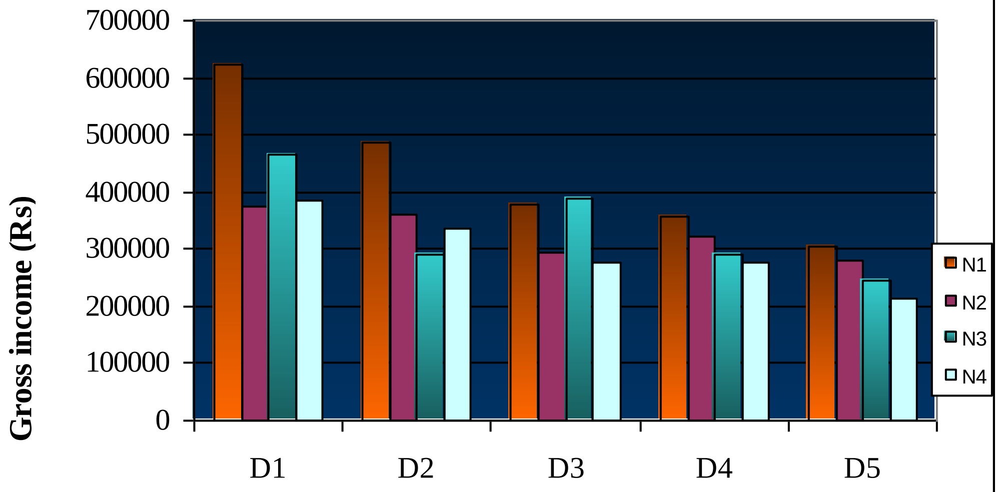

Fig .29a. Effect of date of planting and levels of FYM on gross income of watermelon

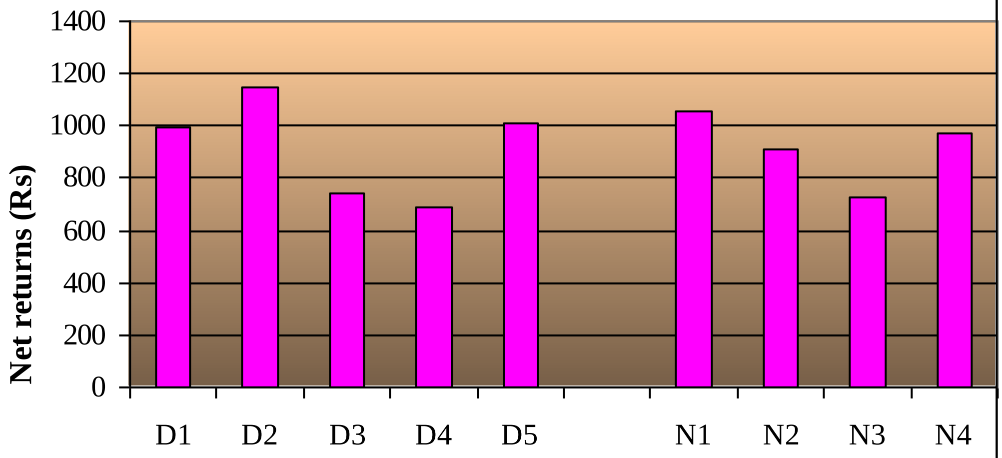

Fig .30. Effect of date of planting and levels of FYM on Net returns

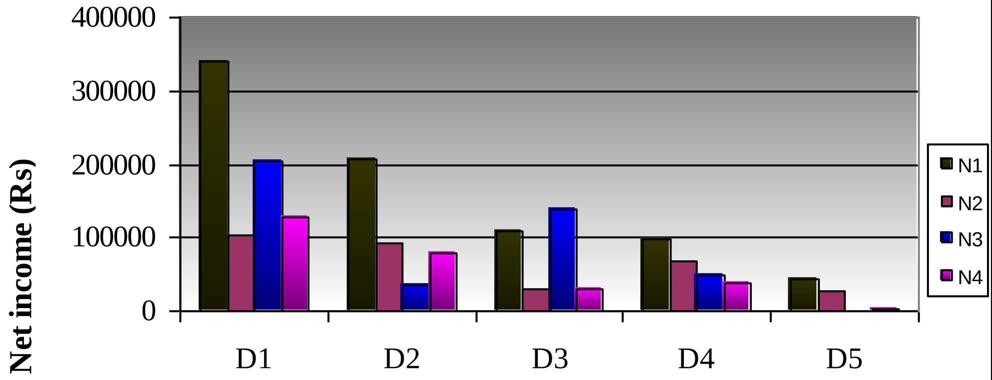

Fig .30a. Effect of date of planting and levels of FYM on net income of watermelon

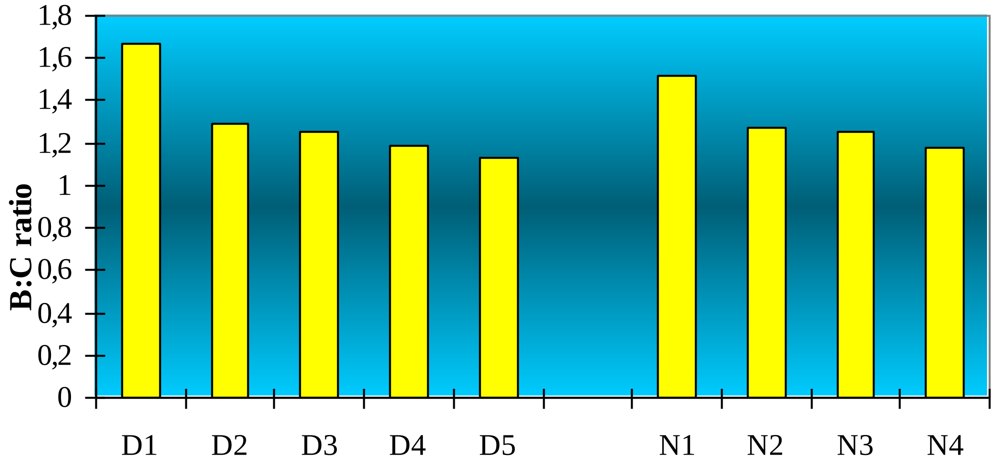

Fig .31. Effect of date of planting and levels of FYM on B:C ratio

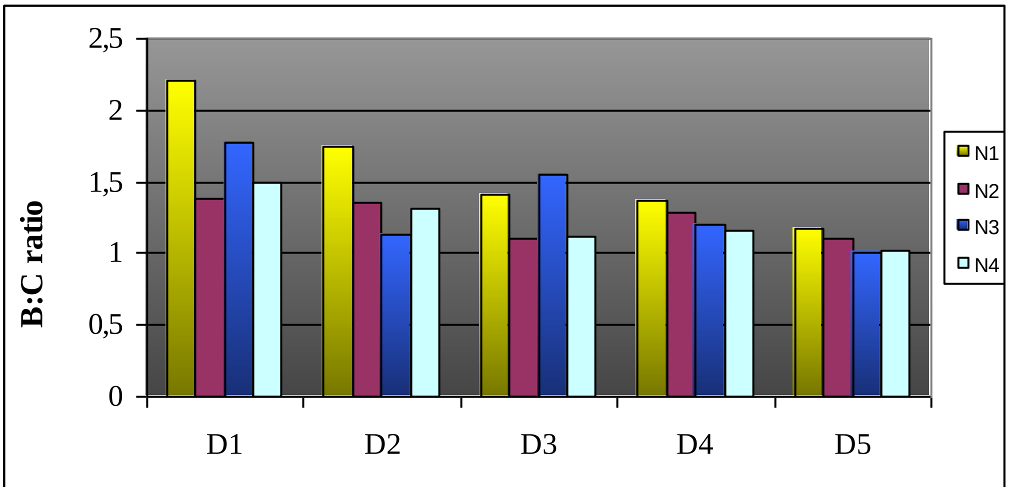

Fig .31a. Effect of date of planting and levels of FYM on B:C ratio of watermelon

Available phosphorus content of soil was significantly increased with the incorporation of FYM.

5.5. EFFECT OF DATE OF PLANTING, LEVELS OF NUTRIENTS AND THEIR INTERACTION ON ECONOMICS OF WATERMELON

The different planting dates and FYM Levels had significant influence on the Gross return, net return and B:C ratio of watermelon. Earlier planting dates showed higher Gross return, net return and B: C ratio of watermelon. The lowest Gross return, net return and BC ratio was reported by December 15th planting. The higher yield for the earlier planting (October 15th) resulted in higher profit for this planting date which in turn increased the B:C ratio.

The high yield produced by the highest level of organic nutrition (5kg FYM plant^{-1}) resulted in higher B:C ratio for these plots. A similar result of increased profit was reported by Raj (1999) in bhindi with organic nutrition. The continuous supply of nutrition for a prolonged period due to organic manuring might have resulted in higher yield in these plots (Thampan, 1993). The higher yield along with high price for the organically produced vegetables has resulted in high B:C ratio.

Summary

6. SUMMARY

An experiment was conducted at College of Agriculture, Vellayani to find out a suitable date of planting and the effect of different doses of FYM on the growth, yield and economics of organic water melon cultivation from October 2010 to March 2011. The findings of the experiment are given below.

Higher number of branches plant^{-1} was noticed by (October 15th) and lowest number of branches plant^{-1} was recorded by December 15th. Significantly higher number of branches plant^{-1} was noticed in plots treated with 5kg FYM plant$^{-1.}$ The lowest number of branches plant^{-1} was recorded by 2kg FYM plant^{-1}.

At harvest maximum vine length was recorded by October 15th planting and it was on par with November 1st planting. Minimum vine length was noticed in the December 15th planting. Maximum vine length was noticed with 5 kg FYM plant^{-1}and it was on par with 4 kg FYM plant^{-1}. The minimum vine length was noticed with 3kg FYM plant^{-1}.

Among the planting dates December 1st took minimum number of days to flower opening and it was on par with December 15th planting. More number of days for flower opening was reported by November 1st planting. The different dates of planting, different levels of FYM, and their interaction could not significantly influence the node to first female flower.

December 1st took minimum days to first harvest and it was on par with December 15th planting. October 15th took maximum days to first harvest and it was on par with November 1st planting. N_4 (POP recommendation) noticed minimum number of days to first harvest and it was on par with N_3 (3 kg FYM plant^{-1}). N_1 (5 kg FYM plant^{-1}) noticed maximum number of days to first harvest.

December 1st took minimum crop duration and it was on par with December 15th planting. October 15th took maximum crop duration and it was on par with November 1st planting. N_4 (POP recommendation) noticed minimum crop duration and it was significantly inferior to other FYM levels. N_1 (5 kg FYM plant^{-1}) noticed maximum crop duration and which was significantly superior to other FYM levels. The highest number of female flowers plant^{-1} was recorded by October 15th planting which was on par with November 1st and lowest number of flowers was observed in December 15th planting.

The highest number of fruits plant^{-1} was recorded by the October 15th planting. The minimum number of fruits was recorded by December 15th planting. The highest number of total fruit plant^{-1} was recorded by 5 kg FYM plant^{-1}. The lowest number of fruits was recorded by POP recommendation.

The highest number of total fruit hactare^{-1} was recorded by October 15th planting. The lowest fruit hactare^{-1} was recorded by December 15th planting. The highest number of total fruit hactare^{-1} was recorded by plants treated with by5 kg FYM plant^{-1}. The lowest fruit hactare^{-1} was recorded by plants treated with by 2 kg FYM plant^{-1}.

October 15th planting recorded significantly higher number of marketable fruits plant^{-1} compared to the other treatments and December 15th planting recorded the lowest. Plants treated with by 5 kg FYM plant^{-1} recorded significantly higher number of marketable fruits plant^{-1} compared to the other treatments and plants treated with by 2 kg FYM plant^{-1} recorded the lowest.

The highest number of marketable fruit hactare^{-1} was recorded by October 15th planting. The lowest number of marketable fruit hactare^{-1} was recorded by December 15th planting. The highest value of marketable fruit hactare^{-1} was recorded by plants treated with by5 kg FYM plant^{-1}. The lowest value of marketable fruit hactare^{-1} was recorded by plants treated with by 2 kg FYM plant^{-1}.

The highest marketable fruit yield hactare^{-1} was recorded by October 15th planting and the lowest fruit yield hactare^{-1} was recorded by December 15th planting. The highest value of marketable fruit yield hactare^{-1} was recorded by plants treated with by 5 kg FYM plant^{-1}. There was no significant difference observed on unmarketable fruit hactare^{-1} with respect to different planting dates, FYM levels and their interaction.

Maximum average fruit weight was recorded by plants sown at October 15th which was on par with November 1st and the lowest at December 15th planting. Average fruit weight was highest in plants treated with by 5 kg FYM plant^{-1} and the lowest in plants treated with by 2 kg FYM plant^{-1}. The fruit length was longest in plants treated with by 5 kg FYM plant^{-1}. It was shortest in plants treated with by 2 kg FYM plant^{-1} which was significantly shorter than other FYM levels.

Maximum fruit diameter was noticed in October 15th planting and it was on par with November 1st planting. December 15th planting recorded minimum fruit diameter. Maximum fruit diameter was recorded in plants treated with by 5 kg FYM plant^{-1}. Minimum fruit diameter was recorded in plants treated with by 2 kg FYM plant^{-1}. Maximum fruit diameter was recorded in October 15th planting with 5 kg FYM plant^{-1}. Minimum fruit diameter was recorded in December 15th planting with 2 kg FYM plant^{-1}.

The flesh thickness was highest in October 15th planting which were on par with November 1st planting. It was lowest in December 15th planting. Maximum flesh thickness was noticed in plants treated with by 5 kg FYM plant^{-1}. Plants treated with by 2 kg FYM plant^{-1}recorded minimum flesh thickness value. The different dates of planting, FYM levels and their interaction could not significantly influence the fruit rind thickness.

The highest value of fruit girth was recorded by October 15th planting and this was on par with November 1st planting. The lowest value was recorded by December 15th planting. The maximum value was recorded by plants treated with by 5 kg FYM plant^{-1}. The minimum value was recorded by plants treated with by 2 kg FYM plant^{-1}.

The different planting dates, different FYM levels and their interaction did not significantly influence the seeds fruit$^{\mathbf{-1}}$ and 100 seed weight. Planting dates exerted a considerable influence on total sugar content. It was maximum in October 15th planting which were on par with November 1st planting. Minimum value was recorded in December 15th planting.

Maximum non-reducing content of the fruit was recorded in October 15th planting which was significantly superior to other planting dates. Minimum value was recorded in December 15th planting which was on par with other planting dates except October 15th.

Either different planting dates, FYM level or their interaction did not show any significant influence on reducing sugar and iron content of the fruit.

The different planting dates, FYM levels and their interaction could not significantly influence the organoleptic characters of fruit. The highest nitrogen uptake value was recorded by October 15th planting and this was on par with November 1st planting. The lowest value was recorded by December 15th planting. The maximum value was recorded by plants treated with by 5 kg FYM plant^{-1}. The minimum value was recorded by plants treated with by 2 kg FYM plant^{-1}.

The highest phosphorus uptake value was recorded by November 1st planting. The lowest value was recorded by December 15th planting. The maximum value was recorded by plants treated with by 5 kg FYM plant^{-1} and this was significantly superior to other FYM levels. The minimum value was recorded by plants treated with by 2 kg FYM plant^{-1}.

The highest potassium uptake value was recorded by October 15th planting and this was on par with November 1st planting. The lowest value was recorded by December 15th planting. The maximum value was recorded by plants treated with by 5 kg FYM plant^{-1}. The minimum value was recorded by plants treated with by 2 kg FYM plant^{-1}.

FYM levels significantly influence available nitrogen content of soil. Among FYM levels maximum nitrogen content was recorded by N_1 (5 kg FYM plant^{-1}) and was significantly superior to all other treatment. POP recommendation was inferior to all treatments.

Various FYM levels significantly influence available phosphorus content of soil. Application of 5kg FYM plant^{-1} registered the highest value and was significantly superior to all other treatment. POP recommendation registered the lowest value.

Available potassium content in soil was significantly influence by different FYM levels. Treatment N_1 (5 kg FYM plant^{-1}) recorded the highest value and was superior to all other treatments. All treatments were significantly superior to N_4 (POP recommendation).

Highest gross return was obtained for October 15th planting and was significantly superior to other planting dates. Lowest gross return was obtained for December 15th planting. Highest gross return was obtained for plants treated with by 5 kg FYM plant^{-1} and was significantly superior to other FYM levels. Lowest gross return was obtained for plants treated with by 2 kg FYM plant^{-1}. Highest gross return was obtained for October 15th planting with 5 kg FYM plant^{-1}. Lowest gross return was obtained for December 15th planting with 2 kg FYM plant^{-1}.

Maximum net return was noticed in October 15th planting and December 15th planting recorded minimum net return. Maximum net return was recorded in plants treated with by 5 kg FYM plant^{-1}. Minimum net return was recorded in plants treated with by 2 kg FYM plant^{-1}. Maximum net return was recorded in October 15th planting with 5 kg FYM plant^{-1}. Minimum net return was recorded in December 15th planting with 3 kg FYM plant^{-1}.

The highest B:C ratio value was recorded by October 15th planting. The lowest value was recorded by December 15th planting. The maximum value was recorded by plants treated with by 5 kg FYM plant^{-1}. The minimum value was recorded by plants treated with by 2 kg FYM plant^{-1}. October 15th planting with 5 kg FYM plant^{-1} recorded highest value and lowest value was recorded by December 15th planting with 3 kg FYM plant$^{-1.}$

Future Line of Work:

Organic production technology for other summer season vegetables along with different organic manure and planting dates need further investigation. Mineralization studies on different organic nutrient sources has to be carried out to assess the exact period of availability of nutrients from organic manures so that the time of application of these manures could be standardized.

References

7. REFERENCES

Abusaleha, S. 1992. Effect of different sources and forms of nitrogen on the uptake of major nutrients of okra. *S. Indian Hort.* 49: 192-196.

AICVIP. 1994. Annual Report 92-93. All India Co-ordinated Vegetable Improvement Project, Vellanikkara, Thrissur.

Akparobi, S. O. 2009. Effect of farmyard manure on the growth and yield of *Amaranthus cruentus. Agric. Tropica et sub tropica*., 42 (1).

Aravind, S. 1987. Evaluation of dynamics of soil physical properties under continuous fertilization and cropping. M.Sc. (Ag.) thesis, Tamil Nadu Agricultural University, Coimbatore, 101 p.

Arokiaraj, A. and Kannapan, K. 1995. Effect of organic waste on yield and economics of rainfed sorghum (Co-25). *Madras Agri . J. 82* :6-8.

Arunkumar, K. R. 2000. Organic nutrition in amaranthus. M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, 123 p.

Arunkumar, S. 1997. Azetobacter and Azospirillum inoculants for nitrogen economy in vegetable cultivation. M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, 125 p.

Baker, J. T. and Reddy, V. R. 2001. Temperature Effects on phonological development and yield of Muskmelon. *Annals of Botany* 87: 605-613, 2001.

Bandgopadhyay, S. and Puste, A. M. 2002. Effect of integrated nutrient management on productivity and residual soil fertility status under different rice-pulse cropping systems in rainfed laterite belt of West Bengal. *Indian J. Agron.* 47: 33-40.

Barani, P. and Anburani, A. 2004. Influence of vermicomposting on major nutrients in bhindi (*Abelmoschus esculentus* L. Moench) var. Arka Anamika. *S. Indian Hort*., 52(1-6): 170-174.

Barker, J. T. and L. H. Allen. 1993. Contrasting crop species responses to CO_2 and temperature: rice, soybean and citrus. *Vegetation* 104/105:239-260.

Bear, E. F. 1965. *Chemistry of the Soil*. Second edition. Oxford and IBH Publishing co., Calcutta, 439 p.

Beckman, E. O. 1973. Organic fertilization: Vegetable farming luxury or necessity. *Technical Communication of ISHA*. pp. 29: 247.

Bhadoria, P. B. S., Prakhash, Y. S. and Amitavarakshit. 2002. Importance of organic manures in quality of rice and okra. *Environ. Ecol*. 20: 628-633.

Bray, R. H. and Kurtz, L. T. 1945. Determination of total organic and available forms of phosphorus in soil. *Soil Sci*., 59: 39-45.

Bruton, B. D., Hartz, T. K. and E. L. Cox, 1985. Vine decline in melon as influenced by cultivar and planting dates. *Hort. Sci*.,20:889-991.

Burki, A. Q. 1996. Effect of different sowing dates on the yield and quality of Tinda Gourd var. Fistulosus under the agro-climatic conditions of Dera Ismail Khan.

M.Sc. Thesis, Department of Horticulture, Faculty of Agriculture, Gomal University, D. I. Khan.

Crowther, E. M. 1935. A note on the availability of organic nitrogen compound in pot experiment. *Indian J . Agric. Sci*., 15: 300-302.

Dademal, A. A. and Dongale, J. H. 1999. Effect of manures and fertilizers on growth and yield of okra and nutrient availability in lateritic soil of Konkan. *J. Soils. Crops*.

Damato, G., Manolio, G. and Bianco, V. V. 1998. Sowing dates, nitrogen rates, pruning and yield of *Lagenaria siceraria (Molina) standl*. In Southern Italy. ISHS *Acta Horticulturae* 467: III International Symposium Diversification of Vegetable Crops.

Dar, A. R., Arun, K. and Samnotra, R. K. 2009. Effect of integrated nutrient management on seed yield contributing parameters. *Asian J. Hort*., 4 (2): 263-266.

Dauda, S. N., L. Aliyu. and U. F. Chiezey. 2005a. Effect of variety, seedling age and poultry manure on growth and yield of garden egg (*Solamun gilo L*.). *The Nigerian Academic Forum* 9(1): 88-95.

Dayakar, S., Rao, A. P. and Rao, T. K. 1995. Effect of organic and inorganic sources of N and P and certain insecticides on the build up of pod borers in pigeon pea. *The Andhra Agric. J*. 42(1-4): 14-17.

Dessi, J. B. and V. K. Patil, 1984. Effects of sowing dates and irrigation on growth, yield and quality of watermelon. *J. Maharashtra Agri. Unv*., 9:34-37.

Dhanorkar, B. A., Borkar, D. K., Puranik, R. B. and Joshi, R. P. 1994. Forms of soil potassium as influenced by long term application of FYM + NPK in vertisol. *J. Potass. Res.* 10: 42-48.

Eifediyi, E. K. and Remison, S. U. 2009. Effect of time of planting on the growth and yield of five varieties of cucumber (*Cucumis sativus L.*) *Report and Opinion*, 1(5): 81-90.

Eifediyi, E. K. and Remison, S. U. 2010. Growth and yield of cucumber (*Cucumis sativus L.*) as influenced by farmyard manure and inorganic fertilizer. *J. Plant Breed. Crop Sci*. 2(7): 216-220.

Farooq, M. M. 1992. Effects of different time of sowing on the yield and quality of muskmelon under agro-climatic conditions of Dera Ismail Khan. M.Sc.Thesis, Department of Horticulture, Faculty of Agriculture, Gomal University, D. I. Khan.

Gaur, A. C., Neelakantan, S. and Dargan, K. S. 1984. *Organic Manures.* Indian Council of Agricultural Research, New Delhi, 159 p.

Gianquinto, G. and Borin, M. 1990. Effect of organic and mineral fertilizer application and soil type on the growth and yield of processing tomatoes. *Rev. Agron*. 24:339-348.

Haris, A. A. 1989. Nutrient management in snake gourd (*Trichosanthes anguina L.*) under partial shade. M.Sc. (Ag.) Thesis, Kerela Agricultural University, Vellanikkara, Thrissur.

Havanagi, G. V. and Mann, H. S. 1970. Effect of rotations and continuous application of manures and fertilizers on soil properties under dry farming conditions. *J. Indian Soc . Soil Sci*. 18: 45-50.

Hedau, N. K., Thakur, M. C., Kumar and Mandal, J. 2001. *Ann. agric. Res. New Series*., 22(3): 404-407.

Heij, G. and Lint, P. J. A. L. 1982. Night temperature and fruiting of glass house cucumber (*cucumis sativus L.) Neth. J. agric. Sci.* 30 (2): 137-148.

Heij, G. 1981. Glass house cucumber, stem elongation and earliness of fruit production as influenced by temperature and planting date. *Acta Horticulturae*. No. 118: 105-21.

Issac, S. R. 1995. Yield, quality and vigour of bhindi seed as influenced by number of harvests and nutrient sources. M.Sc.(Ag.) Thesis ,Kerela Agricultural University, Vellanikkara, Thrissur.

Ivanov, L. and Surlekov, P. 1975. The effect of fertilizer application on cucumber seed yield and quality. *Gradinarskai Lozanska Nauka.*12(2): 47-53.

Jackson, M. L. 1973. *Soil Chemical Analysis*, Second edition. Prentice Hall of India (Pvt.) Ltd., New Delhi, 498 p.

Jagoda, J., Grajewska, H., Charzewski., W. S., Skapski, H. and Viscaddi, K. 1970. The effect of irrigation and mineral and organic fertilization on cucumber yield. *Biuletyn was zywniczy* 1970, 11:109-126. In *Hort. Abst*. 1972. XLII(1):154.

Joseph, P. 1998. Evaluation of organic and inorganic sources of nutrients on yield and quality of snake gourd (*Trichosanthes anguina* L.). M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, 95 p.

Joshi, N. C. and Srivastava, B. K., 2004. Effect of sowing date on sex expression and yield of off-season bitter gourd (*Momordica charantia*) in unheated polyhouse. *J. Agric. Sci 74(3*): 142-3.

Kanwar, J. S. and Prihar, S. S. 1982. Effect of continuous application of manures and fertilizers on some physical properties of Punjab soils. *J. Indian. Soc. Soil Sci*. 10: 242-248.

Kartalov, P. 1970. Possibilities of enhancing the capacity of hot bed cucumbers. *Gardinarstvo*. 12 (3): 35-37.

Katyal, S. L. 1977. *Vegetable Growing in India,* Oxford and IBH Publishing Co ., New Delhi p. 153.

KAU. 1987. Research Report 1987-90. Directorate of Research, Kerala Agricultural University, Thrissur, 82 p.

KAU. 1987. Research Report 1993-94. Directorate of Research, Kerala Agricultural University, Thrissur, 37,152 p.

KAU. 1987. Research Report 1996-97. Directorate of Research, Kerala Agricultural University, Thrissur, 123 p.

Khan, A. Q., Iqbal, M., Jilani, M. S., Ghaffoor, A. and Waseem, K. 2001. Effects of different sowing dates on the yield and quality of tinda gourd(*Citrullus* *vulgaris)* var. Fistulosus under the agro-climatic conditions of Dera Ismail Khan. M.Sc. Thesis, Department of Horticulture, Faculty of Agriculture, Gomal University, D. I. Khan.

Khristov, B. 1983. Suitable methods for melon forcing. *Gradinarskai Lozarska Nauka*. 20(6): 80-83.

Kmiecik, W. and Lisiewska, Z. 1981. Effect of sowing time on cropping dates and yield quality and quantity in 4 processed cucumber cultivars. *Zeszyty Naukowe Adademii Rolniczei im.Hugona Kollataja w Krakowie Ogrodnictwo*. 8: 177-193.

Kumar, N. G., Rajappa, M. G. and Rajagopal, D. 1996. Effect of organic manures on the incidence of stem fly(*Melanagromyza sojas Zhnl*.) in soybean cropping ecosystem. *National Seminar on Organic farming and Sustainable Agriculture*, 9-11 October 1996. Association for promotion of organic farming, Bangalore. Abstract 161.

Kurata, H, 1970. Studies on the formation of female flowers in cucurbits. II. Effect of temperature on the formation of female flowers in water squash (*Cucurbita maxima*) and water-melon. *Tech. Bull. Fac. agric. kagawa*. 21:22-23.

Mangila, E., Tabiliran, F. P., Naguit, M. R. A. and Malate, R. 2007. Effects of organic fertilizer on the yield of watermelon. Threshold volume 2:27-35.

Mesina, N. M. 1986. The effect of cattle dung application supplemented with in organic fertilizer on the yield of muskmelon *CLSU Scientific J. (Philippines)* 6(1): 172.

Minhas, R. S. and Sood, A. 1994. Effect of in organics and organics on the yield and nutrient uptake by three crops in rotation on an acid alfisol. *J. Indian Soc. Soil Sci.* 42: 257-261.

Montagu, K. D. and Ghosh, K. M. 1990. Effect of forms and rates of organic and inorganic nitrogen fertilizers on the yield and quality indices of tomato. *J. Crop Hort. Sci.* 18: 31-32.

Montasser, S. A. 1991. The efficacy of some organic manures in the control of root knot nematode on okra. *Pakist. J. Nematol.*, 9 (2): 139-143.

More, T., Chandra, P. and Singh, J. K. 1990. Cultivation of cucumber (*cucumis sativus*) in green house during winter in north India. *J. Agric. Sci* 60(5): 356-357.

Muhammad, E. G. EL-Habar and A, R. S Muhammad, 1989. Effect of planting dates and plant spacing on the growth and yield of Snake cucumber cv. local, *Ann. Agri. Sci.*, 34:1113-1121.

Naidu, A. K., Kushwah, S. S. and Dwivedi, Y. C. 1999. Performance of organic manures, biological and chemical fertilizers and their combinations on microbial population of soil and growth and yield of okra. *JNKVV Res. J.,* 33 : 34-38.

Nair, M and Peter, K. V. 1990. Organic, inorganic fertilizers and their combinations on yield and storage life of hot chilli. *Veg. Sci* 17(1): 7-10

Nair, R. C. 2003. Sustainable nutritional practices for bitter gourd- Amaranthus intercropping system. M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, 97 p.

Nandpuri, K. S. and Lal, T. 1978. Varietal response to date of planting in muskmelon. *Veg. Sci*. 5(1): 8-14.

Ncebo Sibonelo zulu., 2010. Wild watermelon (*Citrullus lanatus L*.) land race production in response to three seedling growth media and field planting dates. M.Sc. Thesis, Department of Crop science, Faculty of Science and Agriculture, University of Kwazulu-Natal, Pietermaritzburg.

Negi, A. S., Sharma, R. C., Sud, K. C. and Bist, B. S. 1981. Effect of long term manurial application on soil potassium and suitability of different chemical methods of determining available potassium. *J. Indian Soc, Soil Sci*. 29: 86-91.

Ogbonna, P. E. and Obi, I. U. 2007. Effect of time of planting and poultry manure application on growth and yield of egusi melon (*Colocynthis citrullus* L.) in a derived savannah agro-ecology *Journal of Agriculture, Food, Environment and Extension* 6 (2): 33-39.

Oloyede, F. M. and O. C. Adebooye. 2005. Effect of season on growth, fruit yield and nutrient profile of two landraces of *Trichosanthes cucumerina* L. *African Journal of Biotechnology*. 4 (10), 1040-1044.

Omae, K., Fukudome, K., Onjo, M. and Hayashi, M. 2003. Effects of application of cattle compost on yield, quality and soil properties in melon (*Cucumis melo* L.). *Bull. Faculty Agric.* 53: 41-44.

Patidar, M. and Mali, A. L. 2002. Residual effect of FYM, fertilizer and biofertilizer on succeeding wheat (*Triticum aestivum*). *Indian J. Agron.* 47: 26-32.

Patil, M. B., Joghand, S. D. and Jadhar, A. S. 2000. Effect of organic and biofertilizers on yield and quality of okra. *J. Maharashtra agric. Univ.*, 25: 213-214.

Prasad, B and Singh, A. P. 1980. Changes in soil properties with long term use of fertilizers, lime and farm manure. *Indian Soc. Soil Sci*.28 (4): 465-468.

Raj, K. A. 1999. Organic nutrition in okra (*Abelmoschus esculentus* L.). M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, 166 p.

Rajeswari, R. and Shakila, A. 2009. Effect of organic manures on nutrient uptake of palak (*Beta vulgaris* L. var. Bengalensis). *Asian J. Hort*., 4(2): 405-407.

Raju, M. S., Varma, S. C. and Ramiah, N. V. 1991. Effect of phosphorus in relation to FYM vs. Rhizobium inoculation on nutrient uptake by chickpea cultivars under rainfed conditions. *Indian J. Agric. Res.* 25: 43-48.

Rani, P. J., Kannan, M. and Thamburaj, S. 1997. Nutritive value of vegetables. *Kisan Wld.* 24 (2): 53-54.

Rao, T. S. S. S. and Sankar, C. R. 2001. Effect of organic manures on growth and yield of brinjal. *S. Indian Hort*., 49: 288-291.

Ravikrishnan, M. M. 1989. Nutrient management in bitter gourd (*Momordica charantia* L.) under partial shade. M.Sc.(Ag.) Thesis, Kerela Agricultural University, Vellanikkara, Thrissur.

Refai, E. F. S., Hosseny, M. H. and A. S. Badawy. 2008. Effect of planting dates on yield and quality of two cantaloupe hybrids under assiut conditions *Ass. Univ. Bull. Environ. Res*. 11(2) 13-24.

Rivera Segovia, L. 1988. Evaluation of the effects of manuring on the development and yield of melons in tunnels. *In Informes de Investigation CENDIA-RASPA. Gomez Palacio Forestales Agropecuarias* 1988: 241-259 In Soils and Fert. 55(1) :1992: 133.

Sadasivam, S. and Manikam, A. 1992. Biochemical Methods for Agricultural Science. Wiley Eastern Limited, New Delhi, p. 7-8.

Saglam, N. and Yazgan, A. 1999. The effects of sowing date and harvesting intervals on the yield of snake cucumber (*Cucumis melo var .flexuosus. naud*.) as second crop ISHS *Acta Horticulturae* 492: I International Symposium on Cucurbits.

Sedgley, M. and M. S. Buttrose (1978): Some effects of light intensity day length and temperature on flowering and pollen tube growth in the watermelon. *Annuals of Botany* 42: 609-616.

Sekhar, P. and Rajasree, V. 2009. Influence of organic manure on growth yield and quality of okra. *Am. - Eurasian J. Sustain. Agric*., 3(1): 6-8.

Selvi, S. and Ramaswami, P. P. 1995. Residual effect of integrated nutrient management in rice-rice-pulse cropping sequences. *Madras Agric. J.* 82(1): 24-26.

Senthilkumar, R. and Sekar, K. 1998. Effect of organic and inorganic amendments on bhindi in lignite mine soils. *Madras Agrl. J.*, 5(1): 38-40.

Shakila, A. and Anburani, A. 2008. Effect of certain organics and pressmud on growth and yield characters of tomato. *Asian J. Hort*., 3(2): 273-276.

Sharma, A. and Sharma, J. J. 2004. Influence of organic and inorganic sources of nutrients on tomato (*Lycopersicon esculentum*) under high hill dry temperature conditions. *Indian J. Agric. Sci.*, U. K.3:193-195.

Sharma, K. N., Singh, B., Rana, D. S. Kapur, M. L. and Sodhi, J. S. 1984. Changes in soil fertility status as influenced by continuous cropping and fertilizer application. *J. Agric. Sci. Camb*. 102: 215-218.

Sharma, M. D., Tripathi, K. M. and Bhattarai, S. P. 2005. Performance of mahyco green long and bhaktapur local cucumber cultivars at different sowing dates in mid-hill of Nepal. *J. Inst. Agric. Anim. Sci*. 26:163-166.

Sharma, R. C. and Sharma, H. C. 1988. Usefulness of organic manures and their nitrogen fertilizer equivalent. *J. Agric. Sci*. UK. 3 (1): 193-195.

Sharma, R. P., Naveen, D. and Girish, C. 2009. Effect of vermicompost, farmyard manure and chemical fertilizers on yield, nutrient uptake and soil fertility in okra *(Abelmoschus esculentus*) - onion (*Allium cepa*) sequence in wet temperate zone of Himachal Pradesh. *J. Indian Soc. Soil Sci*., 57 (3).

Sharma, S. R., Bhandari, S. C. and Purohit, H. S. 2002. Effect of organic manure and mineral nutrient uptake and yield of cowpea. *J. Indian Soc. Soil Sci*. 50: 475-480.

Shibukumar, V. N. 1995. Variability studies in watermelon [Citrullus lanatus (Thunb.) Mansf.]. M.Sc. (Hort) Thesis, Kerela Agricultural University, Thrissur.

Singh, D. and Mukherjee, S. 2008. Effect of farmyard manure, chemical and biofertilizers on yield and quality of brinjal (*Solanum melongena* L.). *Green Fmg.*, 1 (12): 33-35.

Srivastava, O. P. 1985. Role of organic matter in soil fertility. *Indian J. Agric. Chem*. 18:257

Subbiah, B. V. and Asija, G. L. 1956. A rapid procedure for the estimation of available nitrogen in soils. *Curr. Sci.*, 25: 259-260.

Surlekov, P. and Ivanov, L. 1969. Influence of sowing date on cucumber seed yield. *Gradinarstvo.* 11(12): 14-18.

Thamburaj, S. 1994. Tomato responds to organic gardening. *Kisan Wld.* 21(3): 49.

Thampan, P. K. 1993. *Organics in Soil Health and Crop Production*. Peekay Tree Crops Development Foundation, Kerala.

Thomas, G. 1984. Water management practices for bitter gourd (*Momordica charantia. L*) under different fertility levels. M.Sc (Ag.) thesis, Kerala Agricultural University, Vellanikkara, Thrissur.

Tisdale, S. L., Nelson, W. L. and Beaton, J. D. 1985. *Soil Fertility and Fertilizers*. Fourth edition. Mac Millan Publishing Co., Inc. New York, 733 p.

Valsikova, M. and Ivanic, J. 1982. Effect of FYM on some quality characteristics of capsicum. *Rostlima Vyroba*. 28: 203-210.

Whitaker, T. W. and G. N. Davis. (1962): *Cucurbits, botany, cultivation, and utilization*. World Crop Books, Interscience Pub., N.Y.

PRODUCTION TECHNOLOGY FOR ORGANIC WATERMELON

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ABSTRACT

The present investigation was carried out at College of Agriculture, Vellayani to find out a suitable date of planting and the effect of different doses of FYM on the growth, yield and economics of organic watermelon from October 2010 to March 2011. The experiment was laid out in Split plot design with four replications. The Main plot treatments consisted of five dates of planting (D_1- October 15th, D_2- November 1st, D_3- November 15th ' D_4- December 1st and D_5- December 15$^{th.}$ The sub plot treatment consisted of four levels of nutrients viz. (T_1-5 kg FYM plant^{-1}, T_2-4 kg FYM plant^{-1}, T_3-3 kg FYM plant^{-1} and T_4-2 kg FYM plant^{-1} + 7:2.5:2.5 g NPK plant^{-1} [control] - POP Recommended dose of KAU).

Plants sown on earlier planting date recorded significantly more number of branches, maximum vine length, female flowers plant^{-1}, total fruit plant^{-1}, total fruit ha^{-1}, marketable fruit plant^{-1}, marketable fruit ha^{-1}, marketable yield ha^{-1}, average fruit weight, fruit diameter, flesh thickness and fruit girth compared to the later planting dates. Flower opening was significantly influenced by planting dates.

The earlier planting took maximum days to first harvest and maximum crop duration compared to later planting dates. Quality attributes like total sugar and non-reducing sugar were significantly higher for earlier planting dates. Uptake of N and K was more in earlier planting dates compared to that of later planting dates. Gross return, Net return and B: C ratio of water melon were recorded higher for earlier planting dates.

The highest level of nutrient (5 kg FYM plant $^{-1}$) recorded maximum days to first harvest and took more crop duration. Maximum number of branches plant^{-1}, maximum vine length , total fruit plant^{-1}, marketable fruit ha^{-1}, marketable yield ha^{-1}, average fruit weight, fruit length, fruit diameter, flesh thickness and fruit girth was also recorded by the highest level of nutrient (5 kg FYM plant $^{-1}$) compared to the lower levels of nutrients.

Uptake of N, P and K was also significantly more in plots receiving highest level of nutrient. The available N, P and K content in soil was also significantly more

in plots receiving highest level of nutrient. The highest Gross return, Net return, B: C ratios for watermelon were also recorded by the highest level of nutrient (5 kg FYM plant $^{-1}$).

Appendix

Appendix 1

Weather data for the cropping period
(15th October 2010– 15thMarch, 2011) – Weekly averages

Standard Week	Temperature (° C)		Relative humidity (%)	Rain fall (mm)	Evaporation (mm)
	Max. temp	Min. temp			
40	29.6	23.3	84.4	53.0	2.6
41	29.7	23.5	84.7	17.7	2.8
42	30.8	22.6	82.2	0.4	3.6
43	30.9	23.1	83.4	0.9	3.7
44	30.7	22.7	83.3	4.6	3.3
45	30.4	22.2	83.2	2.9	3.1
46	30.6	21.8	83.2	0.7	3.7
47	30.1	21.8	85.5	14.4	2.8
48	29.6	22.8	84.2	18.6	2.0
49	29.6	23.3	86.2	13.8	2.2
50	29.9	22.9	85.0	1.2	3.2
51	29.8	21.2	85.8	0.0	3.0
52	29.6	21.2	86.0	0.0	3.1
1	30.3	20.3	86.6	0.8	3.3
2	30.4	22.1	86.9	0.0	3.0
3	30.4	21.7	86.2	0.2	3.0
4	30.9	21.2	84.5	0.0	3.3
5	31.2	22.0	83.2	0.0	3.4
6	31.7	21.2	82.1	0.0	3.5
7	31.8	22.4	82.4	0.0	3.6
8	31.6	21.0	81.0	5.0	3.4
9	31.6	23.5	82.8	0.0	3.6
10	32.0	22.2	81.7	0.0	3.8
11	32.6	22.2	79.8	0.0	4.0
12	33.9	23.6	78.6	0.0	4.4