Seminar report

PHOTO INTENSITY ON PLANT CHARECTERS OF RHIZOMATIC SPICE CROPS

By

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DECLARATION

I, Ashwini S (2018-12-023) hereby declare that the seminar entitled ‘Photo intensity on plant characters of rhizomatic spice crops’has been prepared by me, after going through various references cited at the end and has not copied from any of my fellow students.

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25/1/2020 | 2018-12-023

CERTIFICATE

This is to certify that the seminar report entitled ‘Photo intensity on plant characters of rhizomatic spice crops’ has been solely prepared by Ashwini S (2018-12-023) under my guidance and has not been copied from fellow students.

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CONTENTS

1	Introduction	8
2	Effect of photointensity on plant growth	8-9
3	Rhizomatic spice crops	9
3.1	Major rhizomatic spice crops	9
3.2	Under exploited rhizomatic spices	9
4	Photo intensity on rhizomatic spice crops	10
4.1	Influence of photo intensity on morphological characters	10
4.1.1	Influence of photo intensity on plant height and tiller production in turmeric	11
4.1.2	Influence of photo intensity on leaf area and biomass in turmeric	11-12
4.1.3	Influence of photo intensity on number of leaves per shoot, plant height, tillers production in ginger	12-13
4.1.4	Influence of photo intensity on plant height of mango ginger	14
4.2	Influence of photo intensity on physiological characters	15
4.2.1	Photo synthetically active radiation	15
4.2.2	Photo intensity on photosynthetic rate of*Alpiniagalanga*	15
4.2.3	Influence of photo intensity on transpiration rate of ginger	16
4.3	Influence of photointensity on yield	17
4.3.1	Influence of photointensity on yield of turmeric	17
4.3.2	Influence of photointensity on fresh weight of turmeric	18
4.3.3	Influence of photo intensity on ginger	18
4.3.4	Influence of photointensity on rhizome yield in mango ginger	19
4.4	Influence of photo intensity on quality parameters	19-20
4.4.1	Influence of photointensity on concentration of flavonoids and phenols in ginger	20-21
4.4.2	Influence of phtointensity on volatile oil and non volatile oil in ginger	22-23
4.4.4	Influence of photointensity on crude fiber content of ginger	24

4.4.5	Influence of photointensity on curcumin content in turmeric	24
4.5.1	Influence of photointensity on pest and disease	25
4.5.2	Influence of photintensity on shoot borer attack in ginger	25
4.5.3	Influence of photo intensity on rhizome rot of ginger	26
4.5.4	Influence of phtointensity on herbivory damage on *Asaram canadense* (wild ginger)	26
5	Influence of photo intensity in different cropping system	27
5.1	Response of ginger as a intercrop in tamarind plantation	27
5.2	Plant height and yield of ginger as intercrop in sapota–jatropha	27
6	Conclusion	28
7	Discusssion	28
8	Reference	29-30
9	Abstract	31-32

List of plates

Plate No.	Tittle	Page No
1	Major rhizomatic spice crops	9
2	Minor rhizomatic spice crops	10

List of figures

Table No.	Title	Page No.
1	Influence of Photointensity on plant height of turmeric	11
2	Influence of photointensity on tiller production of turmeric	11
3	Influence of photointensity on leaf area of turmeric	12
4	Influence of photointensity on biomass of turmeric	12
5	Influence of photointensity on number of leaves per shoot	13
6	Influence of photointensity on plant height of ginger	13
7	Influence of photointensity on tillers production in ginger	13
8	Influence of photointensity on plant height of mango ginger	14
9	Influence of photointensity on tiller production of mango ginger	14
10	Photosynthetic rate of *Alpiniagalanga*	16
11	Influence of photointensity on transpiration rate of ginger	16
12	Influence of photointensity on yield of turmeric	17
13	Influence of photointensity on fresh weight of turmeric	18
14	Influence of photointensity on rhizome yield in mango ginger	19
15	Influence of photointensity on concentration of flavonoids in ginger	21
16	Influence of photointensity on concentration of phenolic acids in ginger	21
17	Influence of photointensity on concentration of gingerol	21
18	Influence of photointensity on concentration of shagaol	22
19	Influence of photointensity on volatile oil	22
20	Influence of photointensity on non volatile ether extract	23
21	Influence of photointensity on crude fiber content of ginger	24
22	Influence of photo intensity on curcumin content in turmeric	24
23	Influence of photointensity on shoot borer in ginger	25

Photo intensity on plant characters of rhizomatic spice crops

1. INTRODUCTION

Photo intensity refers to the total amount of light that plants receive. It is also described as the degree of brightness that plant is exposed. The intensity of light is usually measured by the unit *lux* (lx) and foot candle(fc). One foot candle means the degree of illumination 1 foot away from a lighted standardized wax candle.100 foot candles is 1 foot away from 100 candles that are lighted simultaneously. Lux is the unit of illumination that a surface receives one meter away from a light source. One foot candle is equal to 10.76391 luces and 1 lux is approximately equal to 0.093 footcandle.

The better unit of light intensity for studiesm involving plant responses is the μmol $m\text{-}^2s\text{-}^1$. It describes the number of photons of light within the photosynthetic waveband that an area of 1 sq meter receives per second. It can be measured using a light meter. To convert the intensity of light from the sun, for instance, 800 μmol $m\text{-}^2s\text{-}^1$ to foot candle, 800 is multiplied by 5 which results to 4,000. Different plants have different requirements of photo intensity both deficient and excessive photo intensities are injurious therefore, it is important to understand how plants response to different photo intensity such as those experienced under field conditions as well as shaded condition.Photo intensity plays a key role in the morphological, biochemical features of rhizomatic spice crops.

2.EFFECTS OF PHOTO INTENSITY ON PLANT GROWTH

Light is an absolute requirement for plant growth and development. However, different plants have optimum requirements and both deficient and excessive light intensities are injurious. The minimum limit for the process of photosynthesis inmost plants is between 100 and 200 fc..Deficient light intensities tend to reduce plant growth, development and yield. This is becauseamount of solar energy restricts the rate of photosynthesis. Below a minimum intensity, the plant falls below the compensation point. Photosynthesis significantly slows down or ceases while respiration continues. Compensation point is the metabolic point at which the rate photosynthesis and respiration are equal so that leaves do not gain or lose dry matter.Photo intensity plays a key role in the morphological biochemical features of plants .

3.RHIZOMATIC SPICE CROPS

Rhizome is a modified stem that grows horizontally in underground and has node and internodesVertical shoots arise from the buds on the rhizome Valued for their aroma, flavor and color .the plant characters of rhizomatic spice crops Influence of photo intensity on morphological characters

3.1 Major rhizomatic spice crops

Ginger (*Zingiberofficinale)*Turmeric(*Curcuma longa)*

3.2 Under exploited rhizomatic spice

Mango ginger (*Curcuma amada*)Wild Ginger (*Asarumcanadense)*

Kasthurimanjal (Curcuma aromatic)Galanga(Alpinia galangal)

4. PHOTO INTENSITY RHIZOMATIC SPICE CROPS

Rhizome is a modified stem that grows horizontally in underground and has nodes and internodes.Valued for their aroma, flavour and colour the secondary metabolites that impart their quality.

Photo intensity plays a key role in plant characters of rhizomatic spice crops such as morphological characters, physiological characters, yield, quality, pest and disease

4.1 INFLUENCE OF PHOTO INTENSITY ON MORPHOLOGICAL CHARACTERS

Photo intensity has a significant influence on plant height, number of tillers, number of leaves and plant biomass

4.1.1 Influence of photo intensity on plant height and tiller production in turmeric

A field experiment was conducted to study the effect of partial shade, inorganic,organic and biofertilizers on morphological parameters,yield and quality of CL 147 in the study 40 different treatment combinations were tried under partial shade and open condition in this study Padmapriya and Chezhiyan (2004) reported that plant height of turmeric was higher under partial shade (Fig.1) and also reported that provision of shade along with organic and inorganic fertilizers was found to enhance the growth of turmeric significantly. In shaded condition increased synthesis of growth promoting hormones like gibberellic acid would haveinduced the apical dominance thereby reducing the tiller production (Fig.2) open condition is favourable for tillers production

Fig. 1: Influence of photo intensity on plant height of turmeric

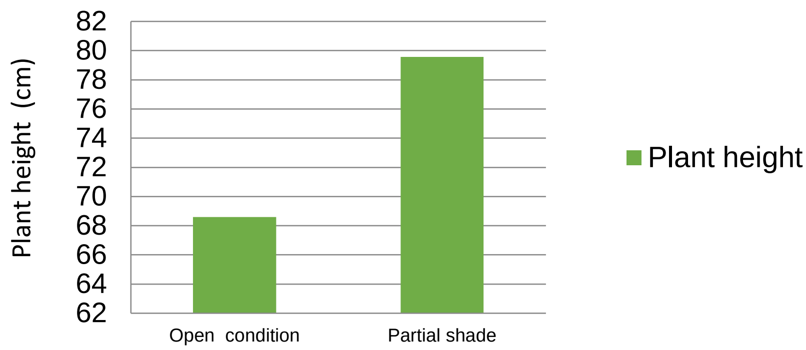
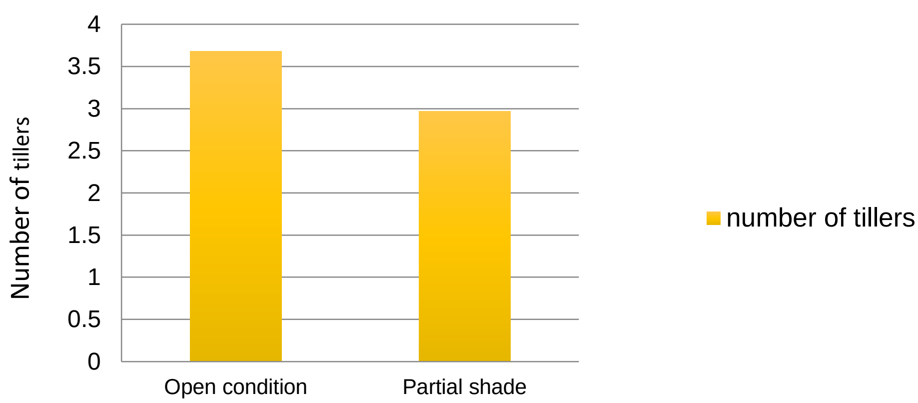


Fig. 2: Influence of photo intensity on tillers production of turmeric



4.1.2 Influence of photo intensity on leaf area and biomass in turmeric

An experiment conducted to evaluvate the growth and development of turmeric under four different shade levels treatment consists of T_1- Open field,T_2 - 50% shade level, T_3 - 70% shade level,T_4 - 80% shade level. The leaf area and biomass were evaluated were measured the results indicated that leaf area, biomass and yield were significantly higher at 50% shade (T_2 - 50% shade) followed by 70% shade (T_3 - 70% shade) than open condition (T_1- Open field). In open condition higher radiation level would caused destruction of photosynthetic pigments and reduction in growth, the shade 70% and 80% shade level solar radiation received by the plants are not sufficient for the optimum photosynthesis.50% shade level was concluded as optimum shade level for cultivation of turmeric.

Fig.3.Leaf area

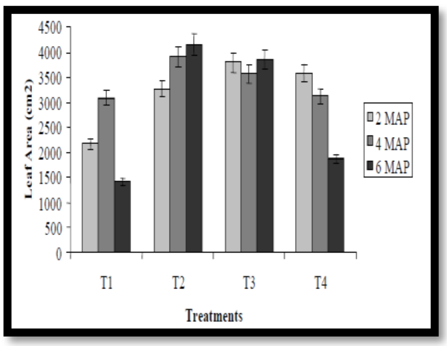
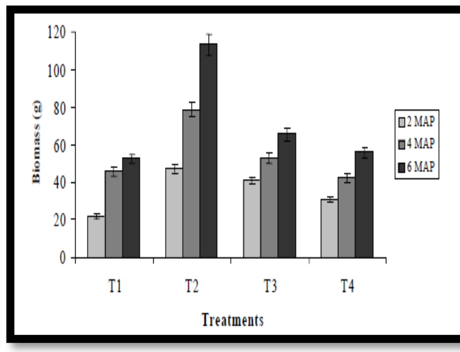


Fig.4. Biomass



T_1- Open field. T_2 - 50% shade. T_3 - 70% shade. T_4 - 80% shade

4.1.3.Influence of photo intensity on Number of leaves/shoot ,Plant height,number of tillers in ginger

The number of leaves per shoot was higher under the open condition,mathew(2018) stated that the number of leaves per clump was higher in open conditionand also the more number of leaves reported in open condition(Fig.5) this leaves plays a major role as a source of carbohydrates production which utilized for production of rhizomeThe influence of photo intensity on morphological characters of ginger were studied and mathew reported that in low photo intensity there was a increment in plant in plant height(Fig.6), in open condition the tillers production was higher and Increment in tiller number tillers due to the new sprouts along with favorable climate conditions during the growth period like optimum atmospheric and soil temperature and relative humidity (Fig.3).

Fig.5.Number of leaves/shoot

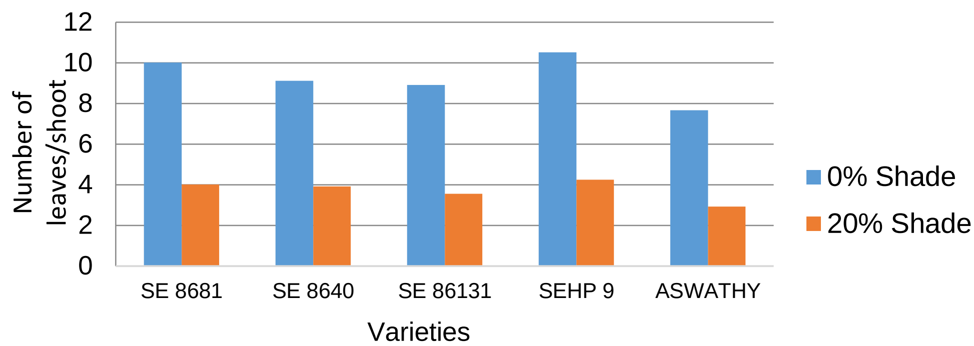


Fig.6.Plant height of ginger

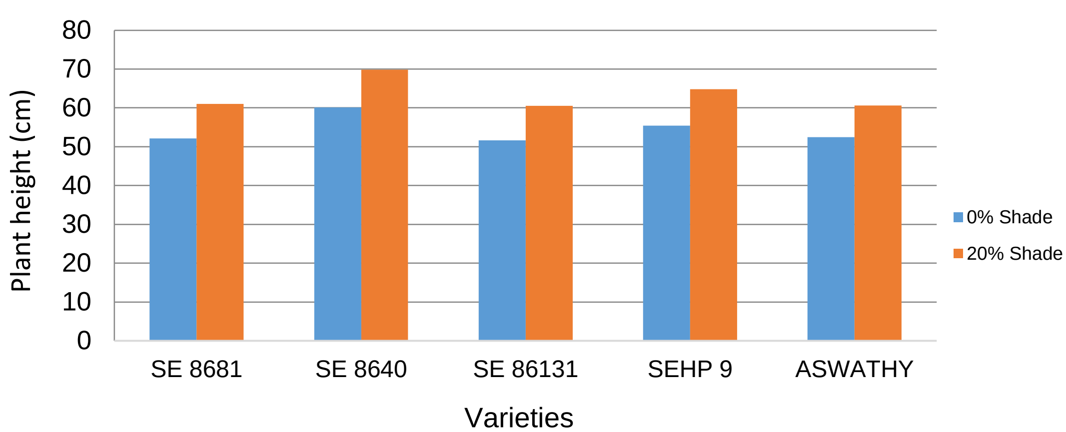
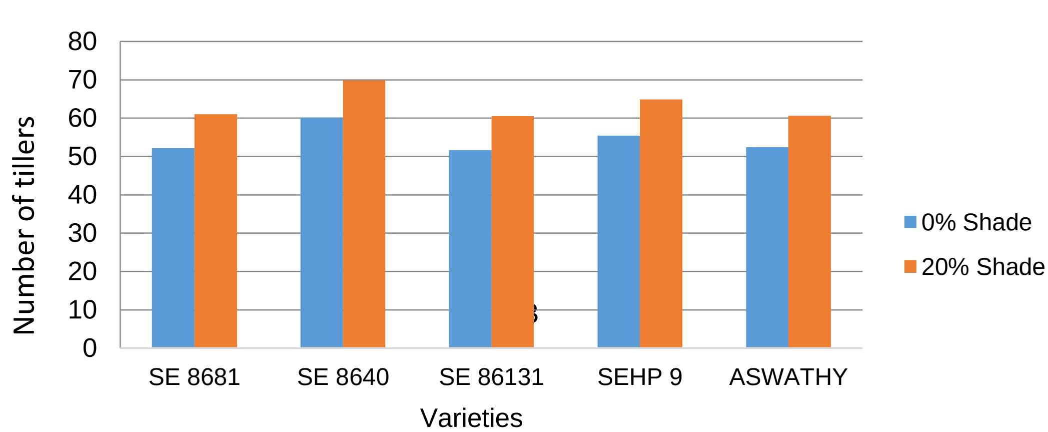


Fig.7 .Number of tillers in ginger



4.1.4.Influence of photo intensity on plant height of mango ginger

Field trials on the performance of mango-ginger *(Curcuma amada)* conducted at Vellayani (Kerala, India) for two seasons under varyinglevels of shade Significant differences were observed on plant height, number of tillers and rhizome yield under open conditions and varying shade intensities. Plants grown under 25, 50 and 75 per cent shade regimes were taller than plants grown under open condition during both the seasons(Fig.8) and tiller s production was higher in open condition (Fig.9) revealed that rhizome yield under open and 25 per centshade were on par indicating that the crop is shade tolerant and is suitable for intercropping situations.

Fig.8:Effect on plant height

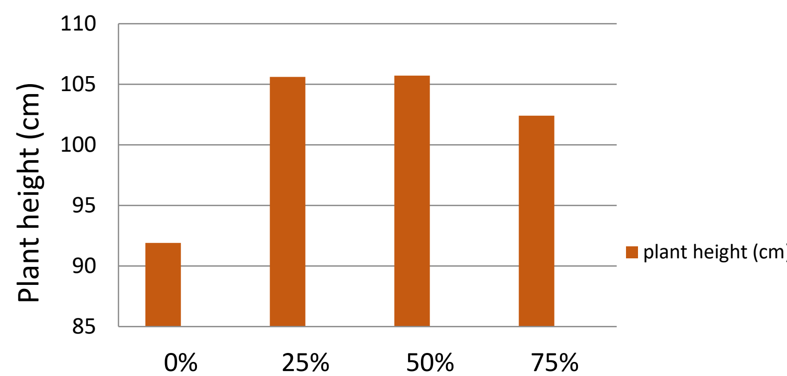
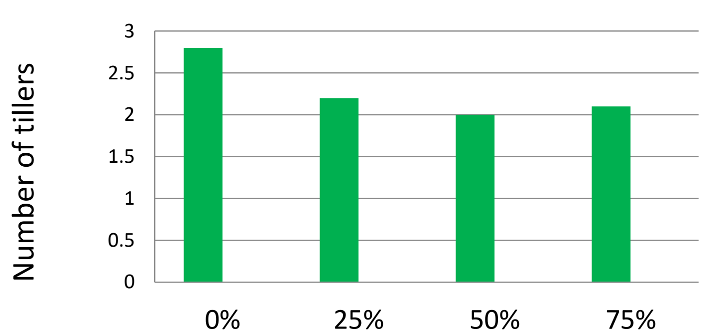


Fig.9.Effect on tiller production



4.2.INFLUENCE OF PHOTO INTENSITY ON PHYSIOLOGICAL CHARACTERS

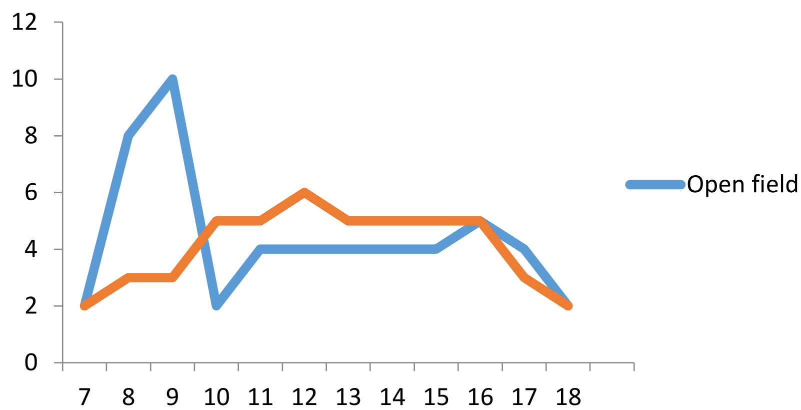
4.2.1.Photo synthetically active radiation

Plants use Photosynthetically Active Radiation for the phosynthesis inthis Blue light : Can promote the opening of stomata.Green light :Improve the development of chloroplast .Red light: Stomata opening, accumulation of photosynthetic production .The intensity and duration of light can affect the amount of photosynthesis

4.2.2.Photo intensity on photosynthetic rate of *Alpinia galanga*

In *Alpinia galanga*PeakPhotosynthetic rate at around 9.00 or 10.00 h in the species studied under open sunlight may be due to light saturation and favourable environmental conditions such as relative humidity and vapour pressure deficit and plant moisture status. The decline in Photosynthesis after 9.00 or 10.00 h may be due to the closure of stomata(Fig.1). A second peak was observed in *Alpinia galangal*at 16.00. Schulze and Hall (1981) ascribed the two-peaked diurnal course of CO2 uptake mainly to the change in the environmental conditions. The first peak occurs in the early morning, but by noon stomata close to such a degree that CO2 uptake decreases. The stomata then open again in late afternoon, resulting in the second peak of CO2 . Only a minor difference was observed in maximum Photosynthesis between open and shade grown plants of *Alpiniagalanga*However, in the case of plants grown in the open condition a sharp decline in Photosynthesis was noticed after the 9.00 h peak. It is widely recognized that shade plants may suffer damage if grown under high irradiance. Also these plants possess only limited capacity for photosynthetic assimilation under high quantum flux densities (Bjorkman 1981). Under shade, all the species in this study maintained maximum Photosynthesis for a longer period. It is a known fact that the leaves must be able to trap the available light under shade and to convert with the highest possible efficiency. The interesting point to note is that the average daily Photosynthesis of leaves of *Alpiniagalanga*.

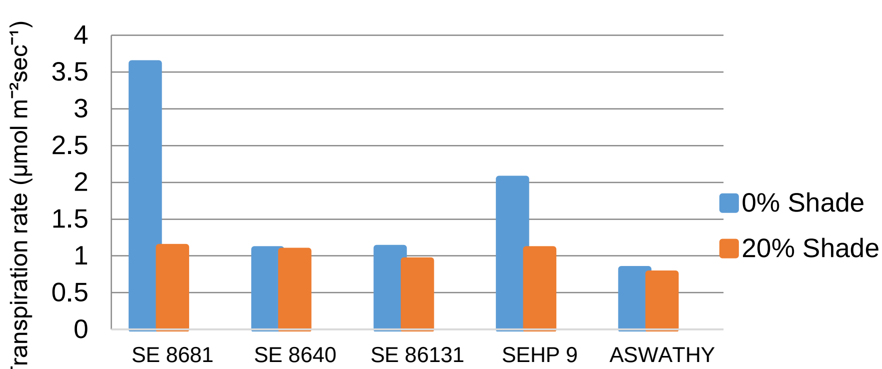
Fig.10..photosynthetic rate of *Alpinia galanga*



4.2.3.Influence of photo intensity on transpiration rate of ginger

Mathew (2018) stated that the traspiration rate was higher under open condition (Fig.1) increasing the light intensity increase the stomatal conductance wh increases the photosynthesis leads to increase the transpiration

Fig.11.Influence of photo intensity on transpiration rate of ginger

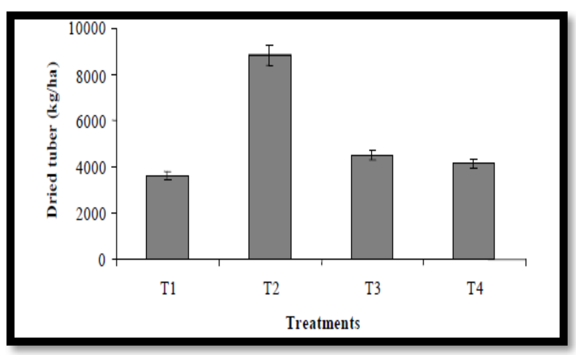


4.3. INFLUENCE OF PHOTO INTENSITY ON YIELD

4.3.1. Influence of photo intensity on yield of turmeric

srikrishnah and suthrsan stated that Partial shade increased yield of turmeric. In 70% and 80% shade levels, amount solar radiation received by the plants may not be sufficient for the optimum photosynthesis. This would have caused reduced yield in treatments 70% and 80% Shade. The highest yield was obtained in 50% shade level. Thus 50% shade level could be optimum for maximum photosynthesis and biomass accumulation. Plant biomass and productivity are interrelated. This might be the reason for the highest concluded that growth and yield performances of turmeric plants were better under 50% shade level.

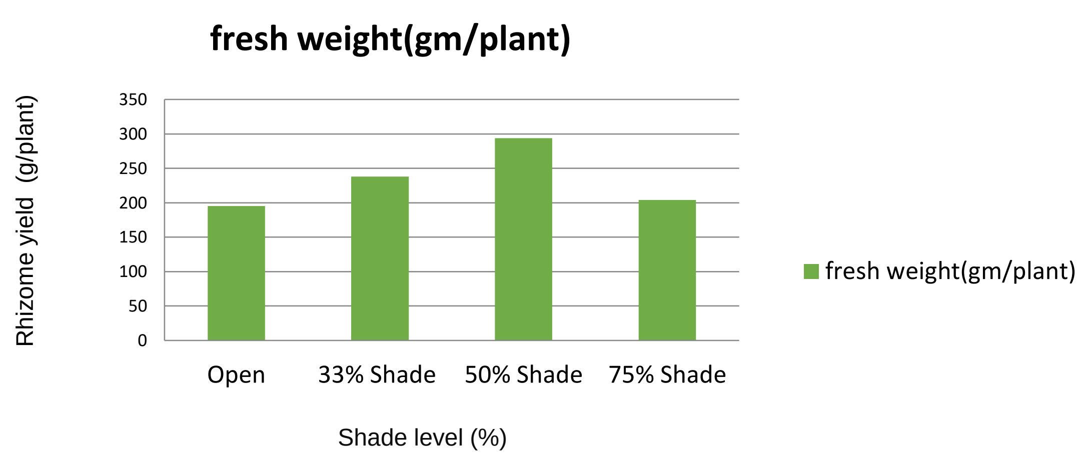
Fig.12. Influence of photo intensity on yield of turmeric



4.3.2.Influence of photo intensity on fresh weight of turmeric

Alam and co workers reported that rhizome yield was higher in 50%Shade due to higher rate of photosynthesis and partitioning of higher amount of photosynthates towads its root Influence of shade on ginger yield

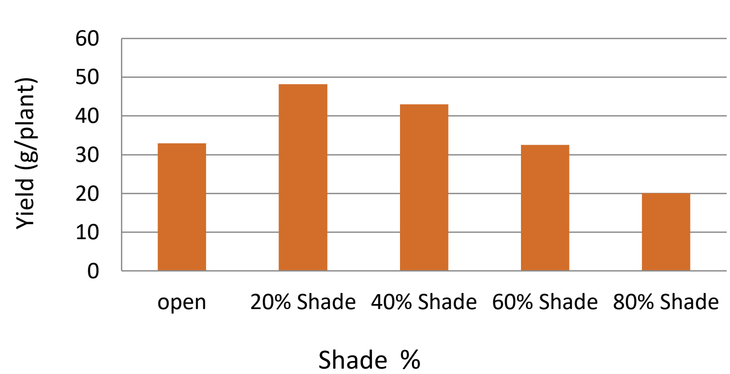
Fig.13. Influence of photo intensity on fresh weight of turmeric



4.3.3. Influence of photo intensity on ginger yie

Ajithkumar and Jayachandran, 2003 reported that the effect of different levels of shade on yield and quality of ginger was studied during two seasons at Coconut Research Station, Thiruvananthapuram, Keral Agricultural University, Kerala. The shade levels 20 and 40 per cent were favourable for obtaining higher dry ginger yield.ginger yields of plants grown under 20-40%shade were on par but produced significantly higher yield when compare to open condition 60-80% shade yield is decreased but open condition is found to be better than 60-80% for rhizome yield low light intensity is favorable for increase photosynthetic efficiency(Fig.1) .Open condition due to threshold illumination intensity beyond which the stomata tends close.`

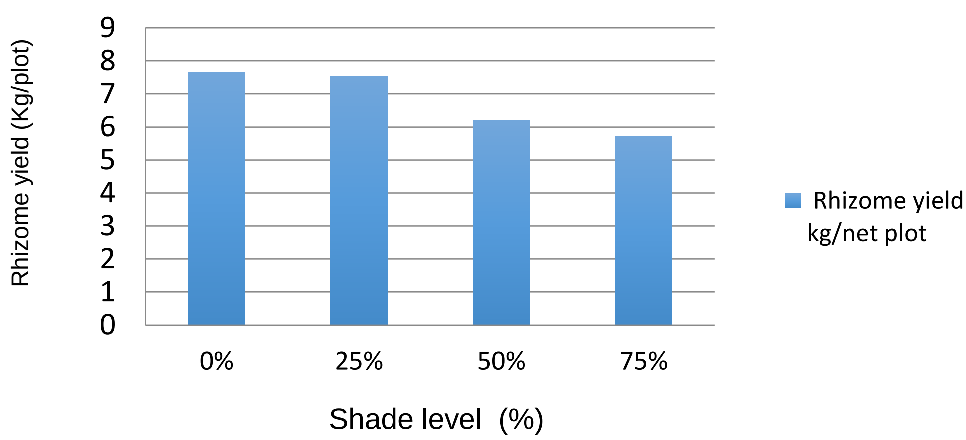
Fig.14. Influence of photo intensity on ginger yield



4.3.4.Influence of photo intensity on rhizome yield in mango ginger

Influence of different levels of shade on growth and yield of mango ginger Field experiments were conducted during 1993 and 1994 at College of Agriculture, Kerala Agricultural University, Vellayani (Kerala, India).In the present study the rhizome yield was not reduced significantly by providing 25 per cent shade, and the yield obtained from open and low shade 25 per cent was on par. Thus mangoginger could be classified as a shade tolerant crop similar to turmeric (Fig.15). Jaya chandran and nair reported that mango ginger yield was higher under open and 25% shade Mango ginger classified as shade tolerant crop

Fig.15. Influence of photo intensity on rhizome yield in mango ginger



4.4.INFLUENCE OF PHOTO INTENSITY ON QUALITY PARAMETERS

4.4.1.Influence of photointensity on concentration of flavonoids and phenols in ginger

The results obtained from the analysis of flavonoids compounds (quercetin, apigenin, luteolin, and myricetin) by HPLC are shown It is apparent that flavonoids accumulation and partitioning in the ginger varieties was considerably affected by the shade.Ghasemzadeh and Ghasemzadeh reported that The different shade level had a significant effect onthe flavonoids synthesis(Fig.16). The synthesis of flavonoids and phenolic acids depends on ecological and physiological factors, but also on ginger. Light has been shown to be the imperative environmental factor influencing phenolic acids and flavonoids synthesis in most plants. The results of current study suggest the ability of different shade level in altering or modifying both the concentration and profiling of phenolic compounds in ginger plants(Fig.17) although accumulation of phenolics compounds favoured high light intensity, the opposite was found for flavonoids where low light intensity generally promoted the accumulation of flavonoids compounds into plant parts. On the other hand, different shade level had a significant effect on the synthesis, accumulation and partitioning in different part of gingers and also different varieties had a different concentration of flavonoids and phenolic acids in different part of plants.

This study demonstrated that shade is able to enhance synthesis of flavonoid compounds in ginger. HPLC analysis revealed that leaves of young ginger had high concentration in almost all flavonoids compounds tested,whilst most phenolic acids seemed to favour the rhizomes. Among phenolics acid compounds studied,gallic acid had more content in both varieties followed by ferulic and vanilic acids. Accordingly, Halia Bara, particularly the leaves, is rich in bioactive compounds, especially in apigenin, when plants grown under low irradiance. Our results in this study indicate that some compounds in Malaysian young ginger varieties like as quercetin, apigenin, luteolin and myricetinposses anticancer activities and may contribute to the therapeutic effect of this medicinal herb. Further work is required to establish this.

Fig.16.Influence of photo intensity on concentration flavonoids in ginger

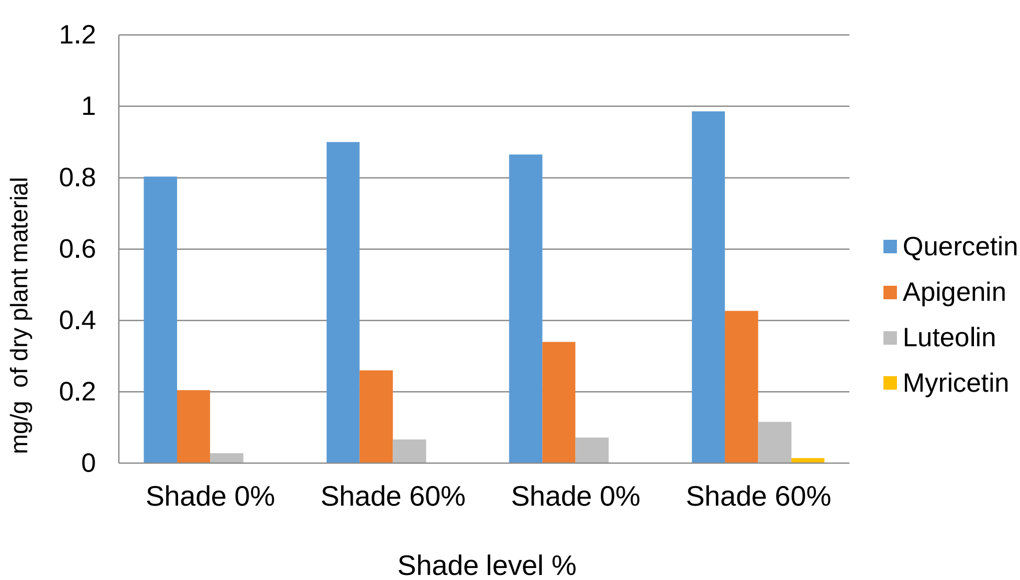
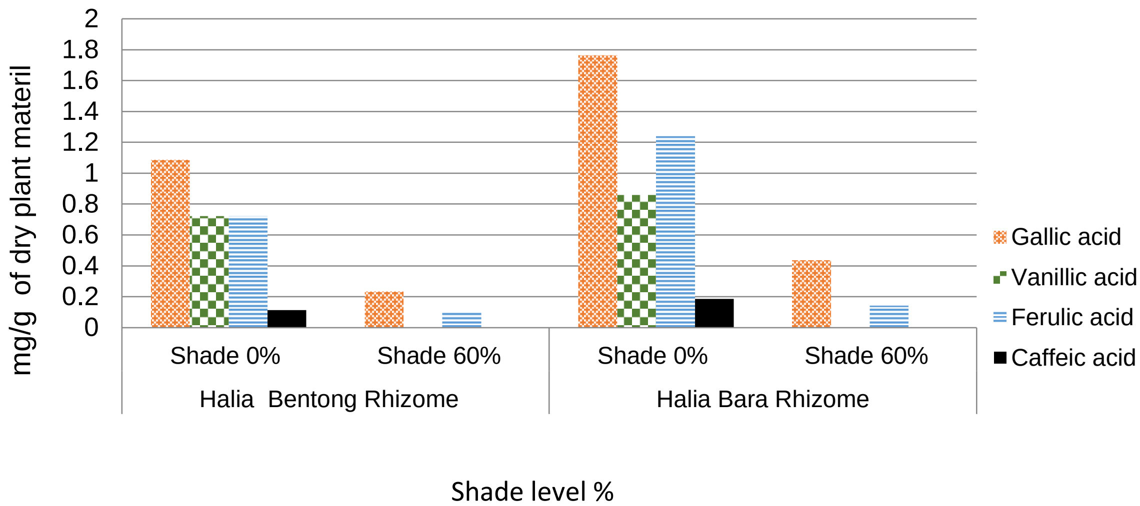
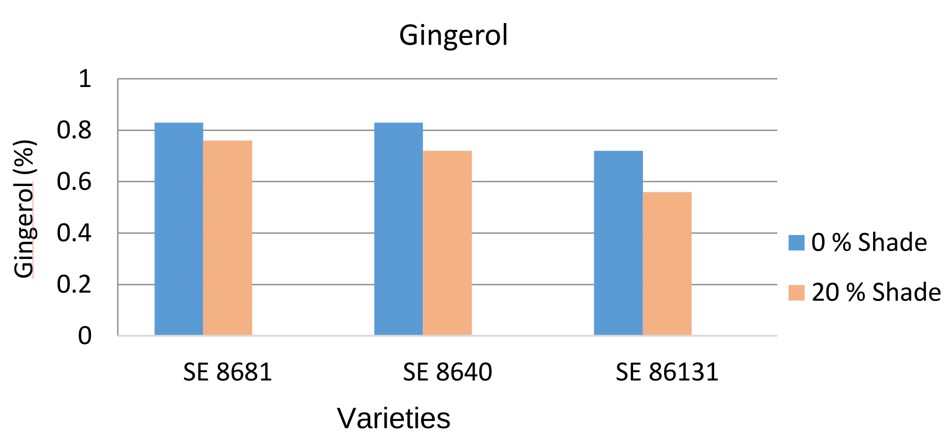


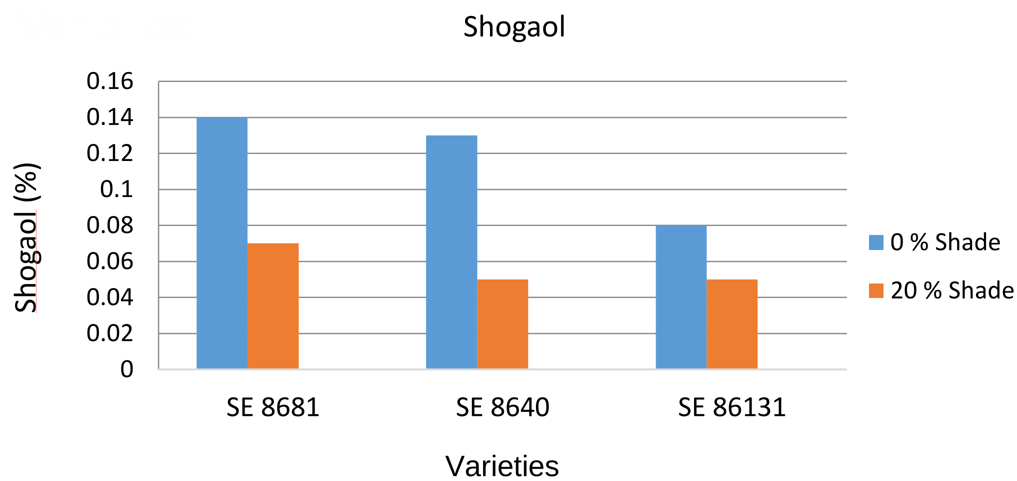
Fig.17.Influence of photo intensity on concentration phenolic acids in ginger



4.4.2.Influence of photo intensity on concentration of gingerol and shogaol in ginger

Mathew reported that the pungent compound gingerol and shagavol pungent compounds of ginger were higher in open condition than the shaded condition

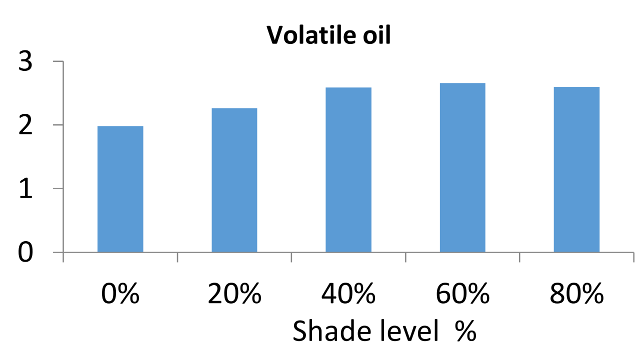




4.4.3.Influence of photo intensity on volatile oil and non volatile oil in ginger

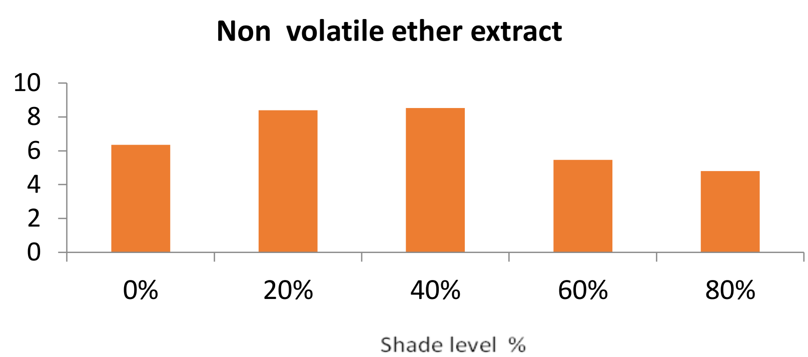
Ajith kumar and jayachandran found that shade grown plants showed higher volatile oil content Found that"volatile oil content under open condition is significantly lower when compared to that in different shade levels. Shade grown plants showed higher volatile oil content (Fig.18). This may be due to the accumulation of secondary metabolites such as resin, resin acids and unoxidised sugars and the retention of volatile oil which otherwise undergoes oxidation, degradation, isomerisation andPolymerization.

Fig.18. Influence of photo intensity on volatile oil



Non-volatile ether extract (NVEE) content varied significantly in different shade levels.During the two seasons, NVEE content under 20 and 40 per cent shade levels, were found to be on par and significantly superior to that under open condition and higher shade levels (60 and 80 per cent).Shade can influence the production of secondary metabolites and reduce the oxidation and other biochemical activities resulting in high NVEE content (Fig.19.)

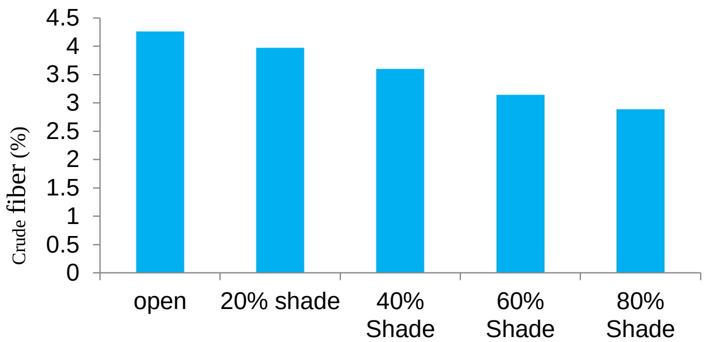
Fig.19. Influence of photo intensity on Non volatile ether extract



4.4.4.Influence of photo intensity on crude fiber content of ginger

The crude fibre content recorded at open condition and 20 per cent shade was on par. As the shade increased there was reduction in crude fibre content. Shade influence the production of secondary metabolites and other biochemical activities. This may be a reason for the reduction in crude fibre content at higher levels of shades. There was not much variation in crude fibre content at different shade levels up to 180 DAP. During 210 and 240 DAP, the plants under open condition recorded maximum fibre content which was on par with 20 and 40 per cent shade levels.

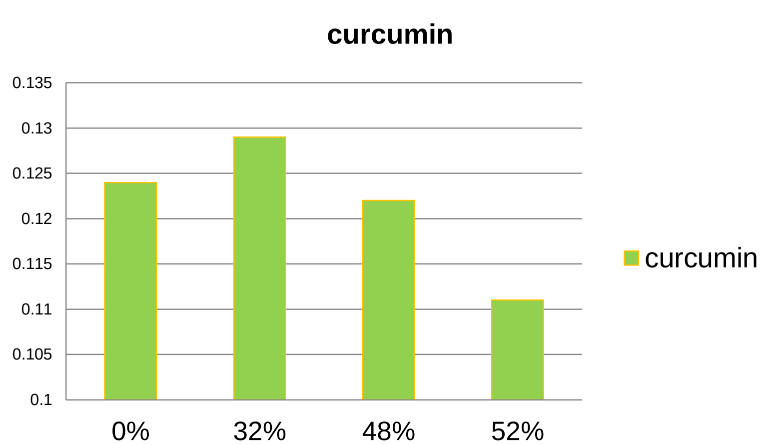
Fig.20.Influence of photo intensity on crude fiber content of ginger



4.4.5 Influence of photo intensity on curcumin content inturmeric

Hossain and co –workers stated that the curcumin content (%) is not influenced by the amount of shoot biomass and rhizome yield but by the some physiological functions that are influenced by Shade,.the curcumin content were higher at 32% shade. Shade increases curcumin content but too shade reduced results antagonistic effects on curcumin accumulation

Fig.21. Influence of photo intensity on curcumin content in turmeric

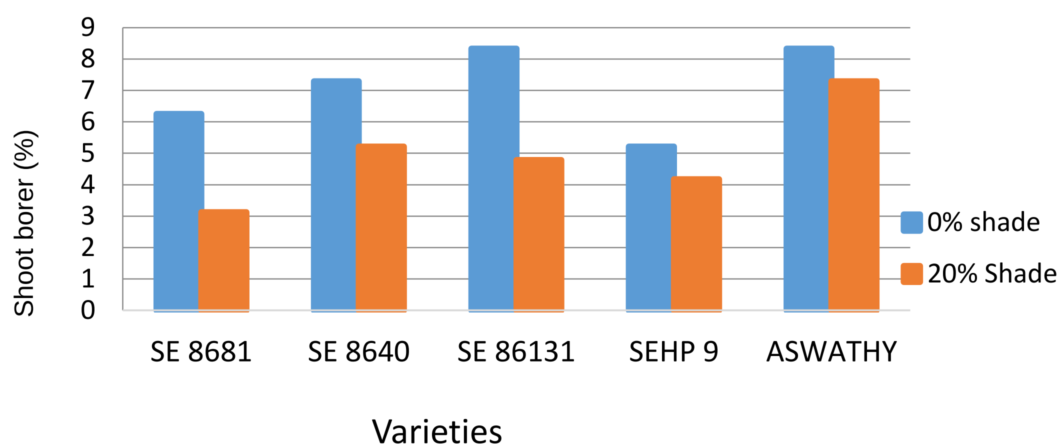


4.5.INFLUENCE OF PHOTO INTENSITY ON PEST AND DISEASE

4.5.1.Influence of photo intensity on shoot borer attack in ginger

Mathew (2018) reported that the shoot borer attack was higher in open condition than the shaded condotion

Fig 22..Influence of photo intensity on shoot borer attack in ginger



4.5.2.Influence of photo intensity on Phyllostictaleaf spot disease in ginger

An experimemnt was conducted at Regional Agricultural Research Station,Indira Gandhi KrishiVishwavidyalaya, Raigarh (Chhattisgarh) during Kharif .Nine plots of each three treatments viz; 1.ginger grown as enter-row with pigeonpea which provided more than 90 % shade till the maturity of ginger (heavy shade) 2.ginger grown with maize which provided 30 - 40 % shade only up to three months (partial shade) 3.ginger grown in open sunlight (without shade), were sown containing 50 rhizomes in each plot. Sowing of rhizomes with pigeonpea and maize was done in such a way that two rows of pigeonpea or maize can provide shade to five rows (50 clumps), each of three meters, of ginger.

All the agronomical package of practices was adopted to raise good crop except the fungicidal spray. Observations on the disease severity and sun burning of leaves were recorded after three months of sowing at the time of maize harvesting Sun burn was recorded (based on the area affected) on twenty randomly selected leaves, from each plot, andaverage was worked out. The disease severity of Phyllosticta leaf spot and sun burn was statistically lower in heavy shade (2.0 % and 0.0 %, respectively) in comparison to open sun grown ginger Reduction indisease severity of Phyllosticta leaf spot, in heavy and partial shade, most probably may be due to increase in calcium content in heavy shade as recorded. Reduction in the sun burn of the leaves under heavy shade followed by partial shade(0.0 % and 4.4 %, respectively) , in comparison to open cultivation (19.8 %)

4.5.3.Influence of photo intensity on rhizome rot of ginger

Plants grown under the shade condition contain more of essential oil possessing bactericidal and fungicidal properties they by conferring reistance under shade

4.5.4 Influence of photo intensity on herbivory damage in *Asarumcanadense*(Wild Ginger)

Asarumcanadense(Wild Ginger) growing in varying light regimes show differences in herbivore damage as a result of differences in the amount of secondary defense chemicals. Populations of wild ginger were studied to assess the percentage of herbivory on leaves in relation to the percentage of canopy cover. A significant positive correlation between shade intensity and herbivory was found among individualsas well as across patches .The results suggest that plants with access to more light are probably able to allocate more energy to the production of defense chemicals. Furthermore, these results show that although A. *canadense*is equipped to survive in high shade conditions, it becomes increasingly susceptible to herbivory as shade increases optimized photosynthesis and defense against herbivory of A. canadense in varying light intensities With increased light levels, individual plants showed lower levels of herbivory . suggesting that they had more resources to allocate to chemical or physical defenses. This pattern was much stronger for average damage per patch growing under one light condition .Thus, under increased light levels, plants seem to harness enough energy for basic growth and survival and utilize any extra resources to defend against herbivory.. We show that even very small and subtle differences in the amount of light in natural populations of this shade-tolerant plant can result in significantly different levels of herbivory. Thus, A. canadense displays a critical balance between not being able to harness enough energy for defense and damage (bleaching of leaves) through excessively high light levels.

5.INFLUENCE OF PHOTO INTENSITY IN DIFFERENT CROPPING SYSTEM

In intercropping can exploit the resources better than either of them grown separately.The choice of intercrop is important as the economic returns depend on particular tree species the performance of the intercrop is affected by root system, canopy,Efficient interception of solar radiation

5.1.Response of ginger as an intercrop in tamarind plantation

Kumar *et al.*, 2010 reported that six years old tamarind plantation Plant under diffused light generally grow taller and produce more foliage as observed in this study25,229 lux intercrop,31,643 lux open

5.2.Plant height and yield of ginger as intercrop in sapota – jatropha

The field experiments were conducted under support irrigated conditions in Navsari Agricultural University, Navsari (Gujarat). The nine year old plantation ofSapota (*Manilkaraacharas* with seven year old plantation of Jatropha (*Jatrophacurcas*L.) was used for the present intercropping study. The ginger crop with two varieties *viz*. *Zingiberofficinale*L var. Navsari local and *Zingiberofficinale*L. var. Udaipur local was selected for the study. The experiments were laid out in randomized block design with eight treatments and three replications. The observations on growth andyield were recorded during the course of investigation under study for both the years. At the harvesting stage, maximum fresh rhizome yield and total number of fingers per plant, Plant height, length of rhizome, width of rhizome and survival percent of ginger was registered under Sapota + Jatropha compared to their sole cropping.These results indicate that both the varieties of ginger performed better either intercropped with sole Jatropha or with Sapota +

Jatropha agro-forestry systems in comparison to the sole cropping and cropping under sole Sapota.However, ginger var. Udaipur local performed better than ginger var. Navsari local in all the agroforestry systems for width of rhizome (cm) in both years.

6.Conclusion

The exposure to different levels of photo intensity has a crucial role in determining the plant characters, yield and quality of rhizomatic spice crops. Thus, knowledge regarding the influence of photo intensity is relevant for spice crops production.

7.Disscussion

1.Shaded Plants are less affected by rhizome rot of ginger

Plants grown under the shade condition contain more of essential oil possessing bactericidal and fungicidal properties they by conferring resistance under for disease.

2. What is the use of wild ginger, weather it is found in india or not?

Wild ginger is known as colic root it is used in treat stomach problems.in india only few parts of Assam and Himalayan region.

3.why phenols and shagol are higher under open condition?

gingerol and shagavol pungent compounds of ginger were higher in open condition than the shaded condition this belongs to phenolic group phenoli acid synthesis is favored under open condition.

8.Reference

Bhuiyan, M.M.R., Roy, S., Sharma, P.C.D., Rashid, M.H.A. and Bala, P., 2012. Impact of multistoreyed agro-forestry systems on growth and yield of turmeric and ginger at Mymensingh, Bangladesh. *Sci Journal of Crop Production*, *1*(1), pp.19-23.

Ghasemzadeh, A. and Ghasemzadeh, N. 2011. Effects of shading on synthesis and accumulation of polyphenolic compounds in ginger (*Zingiberofficinale* Roscoe)varieties. *J. Med. Plant Res*. 5(11): 2435-2442.

Jayachandran, B. K. and Nair, G. S. 1998. Performance of mango ginger (Curcuma amadaRoxb.) under different levels of shade. J. spices aromatic crops. 7(2): 145-146.

Mathews, N. 2018. Screening ginger (*Zingiberofficinale*Rosc.) genotypes under different growing condition and for value addition. Ph.D. (Hort.) thesis, Kerala Agricultural University, Thrissur. 159p.

Padmapriya, S. 2004. Studies on effect of shade, inorganic, organic and bio fertilizers on growth, yield and quality of turmeric (*Curcuma longa* L.) genotype CL 147. Ph.D. (Hort.) thesis, Tamil Nadu Agricultural University, Coimbatore. 256p.

Sangeetha, k. And subramanian, s., 2015. Evaluation of ginger (tion of ginger (tion of ginger (zingiberofficinalezingiberofficinalezingiberofficinalerosc.) Genotypes under coconut ecosystem.

Singh, A. K., Singh, S., and Edison, S.2004. Effect of shading on the Phyllosticta leaf spot, sun burn of leaves and yield of ginger. *Indian Phytopath*, 57(2):197-199.

Srikrishnah, S. and Sutharsan, S. 2015. Effect of different shade levels on growth and tuber yield of turmeric (*Curcuma longa* L.). *J.Agric. Environ. Sci.* 15 (5): 813-816.

Pandey, S.B.S., Pandey, M., Jadeja, D.B., Tandel, M.B. and Nayak, D., 2017. Growth and yield of ginger (Zingiberofficinale L) under Sapota-Jatropha based agroforestry systems in south Gujarat. *Journal of Pharmacognosy and Phytochemistry*, *6*(6), pp.247-251.

Meenu, G. and Kaushal, M., 2017. Diseases infecting ginger (Zingiberofficinale Roscoe): A review. *Agricultural Reviews*, *38*(1), pp.15-28.

Nath,P.D.,1993.Effect of shade and treatment for rhizome rot of ginger.Annals of Agricultural resarch,14(3),pp.327-328.

Babu, M.S., Kumar, B.P., Swami, D.V., Krishna, K.U. and Emmanuel, N., 2017. Performance of Ginger (ZingiberofficinaleRosc) Varieties under Shade Net Condition of Costal Andhra Pradesh. *Int. J. Curr. Microbiol. App. Sci*, *6*(7), pp.494-498

Ghasemzadeh, A., Jaafar, H.Z. and Rahmat, A., 2010. Synthesis of phenolics and flavonoids in ginger (ZingiberofficinaleRoscoe) and their effects on photosynthesis rate. *International journal of molecular sciences*, *11*(11), pp.4539-4555.

Gopichand, R.L. and Singh, R.D., 2017. Effect of different tree shading on the growth and yield of Curcuma aromaticasalisb. *Journal of Medicinal Plants*, *5*(5), pp.132-136.

9.ABSTRACT

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Department of Plantation Crops and Spices
PSMA 591: Master's Seminar

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Admission No : 2018-12-023
Major Advisor : Dr. Jalaja S. Menon

Venue: Seminar hall
Date : 17-01-2020
Time : 10.45 am

Photo intensity on plant characters of rhizomatic spice crops

Abstract

Photo intensity refers to the total amount of light that plants receive. The intensity of solar radiation received is a critical factor in deciding crop production. Optimum light intensity is required for a plant to perform better and deficient and excessive light intensities are injurious.

In rhizomatic spice crops, photo intensity is one of the prime factors that decide the plant characters and yield. The important rhizomatic spice crops like ginger and turmeric are included in many cropping systems based on its performance in differential photo intensity.

The extent of photo intensity has a significant influence on morphological characters and yield of rhizomatic spice crops. Srikrishnah and Sutharsan (2015) reported that 50 per cent shade level was found to be optimum for growth and yield of turmeric, while ginger prefers a shade level of 25 per cent for better performance (Varughese, 1989). Jayachandran and Nair (1998) has suggested 25 per cent shade level for better yield in mango ginger.

The quality parameters significantly vary with photo intensity levels. The content of pungent principles of ginger such as gingerols and shogaol were found higher at 20 per cent shade (Mathews, 2018). The amount of flavonoids such as quercetin, catechin, epicatechin and naringin were found to be high in ginger rhizome grown under 60 per cent shade whereas, accumulation of phenolic acids was favored at high light intensity (Ghasemzadeh and Ghasemzadeh, 2011). The phytoconstituents like curcumin, oleoresin and essential oil in

turmeric were higher under 25-30 per cent shade compared to open condition (Padmapriya, 2004).

Light intensity also affects the disease incidence in crops. The disease severity of Phyllostictaleaf spot of ginger was less in crop grown at a shade level of 30-40 percent (Singh *et al*.,2004).

The exposure to different levels of photo intensity has a crucial role in determining the plant characters, yield and quality of rhizomatic spice crops. Thus, knowledge regarding the influence of photo intensity is relevant for the rhizomatic spice crops production.

References

Ghasemzadeh, A. and Ghasemzadeh, N. 2011. Effects of shading on synthesis and accumulation of polyphenolic compounds in ginger (*Zingiberofficinale*Roscoe) varieties. *J. Med. PlantRes*. 5(11): 2435-2442.

Jayachandran, B. K. and Nair, G. S. 1998. Performance of mango ginger (*Curcuma amada*Roxb.) under different levels of shade. *J. Spices Aromat. Crops* 7(2): 145-146.

Mathews, N. 2018. Screening ginger (*Zingiberofficinale*Rosc.) genotypes under different growing condition and for value addition. Ph.D. (Hort.) thesis, Kerala Agricultural University, Thrissur. 159p.

Padmapriya, S. 2004. Studies on effect of shade, inorganic, organic and bio fertilizers on growth, yield and quality of turmeric (*Curcuma longa* L.) genotype CL 147. Ph.D. (Hort.) thesis, Tamil Nadu Agricultural University, Coimbatore. 256p.

Singh, A. K., Singh, S., and Edison, S.2004. Effect of shading on the Phyllosticta leaf spot, sun burn of leaves and yield of ginger. *Indian Phytopathol.*57(2):197-199.

Srikrishnah, S. and Sutharsan, S. 2015. Effect of different shade levels on growth and tuber yield of turmeric (*Curcuma longa* L.). *J.Agric.Environ. Sci.* 15(5): 813-816.

Varughese, S. 1989. Screening of varieties of ginger and turmeric for shade tolerance. M.Sc.(Ag.) thesis, Kerala Agricultural University, Thrissur. 81p.