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Effect of row direction and row spacing on micro-climate in castor based intercropping system

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Abstract

The field experiment entitled "Effect of row direction and row spacing on microclimate in castor based intercropping system" was conducted during the kharif season of 2017-18 at Regional Research station, Bawal, CCS HAU with the objective of quantification of microclimate, relation of microclimate with growth and yield of castor, The experiment was laid out in split plot design and replicated thrice with 12 treatment combinations comprised of two row direction (East-west and North-south) as main plots and six treatments comprised by two row spacing 180cm x 60cm and 240cm x60cm, two intercrops such as mungbean and fenugreek in 1:4 and1:6 combinations. The results indicated that higher air temperature and PAR observed in North-south whereas relative humidity was higher in East-west. Air temperature and PAR had negative effect on plant height whereas relative humidity on number of branches per plant and number of capsules per spikes.

Keywords: Castor, microclimate, intercropping, growth and yield

Introduction

Castor (*Ricinus communis* L.) is the most primitive non-edible oilseed crop, belongs to family *Euphorbiaceae*. This is one of the most suitable oilseed crop for arid and semi-arid parts of country, which can be used to fulfil the ever increasing demand of industrial oil. Castor, due to its low input and water requirement, low cost of production and higher economic returns, is getting popular among the farmers in the country. This would also minimize salinity problems and improve soil health. Now a day with increasing demands for castor oils for industrial purposes, castor fetches good market price and provides higher economic returns.

Microclimate is the climate which is usually within the reach of crop canopy (Rosenberg *et al*., 1983) [7]. Microclimate of a crop field can be manipulated for the growth and yield of crops. Temperature, radiation and moisture are basic meteorological parameters of agricultural significance. Under potential conditions, with adequate moisture and fertility plays the role of decisive factor for crop growth and development. Relative humidity along with temperature, rainfall and wind velocity independently or in combination, can influence crop growth and productivity. For Indian conditions, 50-60% relative humidity in air is optimum for castor crop. If this is less, moisture loss occurs due to high evapo-transpiration and results in more water demand. Disease infestation also increases when there is high humidity coupled with high temperature. Thus; manipulation of humidity profile within a crop field by an appropriate adoption of crop stand geometry, like row orientation and row spacing can provide a means to create favourable conditions for crop canopy for purpose of efficient harvest of natural energy for agricultural production (Sandhu *et al.*, 2012).

Intercropping has been recognized as a potentially beneficial system of crop production which can provide sustained yield advantages as compared to sole cropping. To take the advantages of different rooting depths, duration, nutrient and water requirement of the crops and better utilization of all the resources, the concept of intercropping has been introduced in primitive agriculture. These advantages are especially important because they are achieved not by means of costly inputs but the simple expedient of growing crop together. It provides an insurance against total crop failure and also reduces soil erosion if the plants of the subsidiary crops have the trailing habit. Reddy *et al*. (2008) [6]. reported that pulses had a complementary effect and cereals had a competitive effect when they were grown as intercrops with castor.

Material and methods

A field experiment was conducted at Regional Research Station, Bawal during *Kharif* 2017 under irrigated condition. The experiment was laid out in split plot design and replicated thrice with 12 treatment combinations comprised of two row direction viz. East-west (M_1) and North-south (M_2) as main plots and six treatments comprised by two row spacing 180cm x

60cm and 240cm x 60cm, two intercrops such as mungbean and fenugreek in 1:4 and1:6 combinations.

The castor crop (variety DCH-177) was sown by dibbling with onset of monsoon (7th July of 2017) at row spacing as per treatments with seed rate of 5 kg ha^{-1}. Mungbean seeds were sown on same day by line sowing method. At each spot two seeds of castor were dibbled in their respective rows in differential row proportion according to the treatments allotted in the plan and after complete germination of castor only one plant was allowed to grow. Castor as sole crop and 1:4 row proportion intercropping system was sown at spacing of 180 cm x 90 cm and in 1:6 row proportions intercropping was sown at spacing of 240 cm x 90 cm. The intercrops *viz*. mungbean and fenugreek were sown at a spacing of 30 cm x 10 cm as sole crops. While, four rows of intercrops were sown in between two rows (180 cm) of castor in 1:4 row proportion and six rows of intercrops were sown at a spacing of 30 cm in between two rows (240 cm) of castor in 1:6 row proportion. Fenugreek has sown on 15th Oct of 2017 by leaving 30cm both sides of castor rows.

Result and discussion

1. Microclimate measurement

Microclimate parameters like air temperature, relative humidity and photo-synthetically active radiation in each plot of castor were measured from 50% flowering stage to maturity of primary spike (60 DAS to 120 DAS) in East-west and North-south orientations. Air temperature measured (ºC) inside crop canopy and relative humidity measured (%) at 08.00, 12.00 and 16.00 hr in crop rows were averaged and presented.

It observed that air temperature was declining as the growth of crop proceeds it might be because of increased leaf area and canopy development resulted in more reflection of the solar radiation. Row orientations showed difference in recorded air temperature. It was higher in North-south sown crop over East-west crop row (Table 1). It may be due to efficient penetration of radiation in rows as compared to East-west sown crop where shading effect was caused. The same finding was reported by Sandhu *et al.* (2012). Higher air temperature was recorded in crop sown with wider spacing (240 cm) than closer spacing (180 cm). Row spacing showed more variation in canopy temperature at all growth stages. However it is contrast to observation made by Pandey *et al.* (2013) [5], who observed no variation in canopy temperature between row direction of wheat crop. Air temperature measured between crops rows both in sole castor and intercropped treatments found lower over control where no crop was taken. This might be because of latent use of solar radiation for evapo-transpiration (cooling effect).

Increasing trend of relative humidity was observed in all treatments towards maturity of crop (Table 2). This study revealed that among different row directions, more relative humidity was recorded in East-west row direction. It might be due to shading effect of rows in East-west oriented rows and prevailing wind might have brought out the vapour content inside rows to far. However contrast finding was made by Sandhu *et al.* (2016) [8]. Closer row spaced crop (180cm) was experienced higher relative humidity over wider row spaced crop (240cm) and same conclusion was made by Yang *et al.* (2008) [9]. Obviously, castor grown in sole as well as intercropped with others crops showed higher relative humidity over control treatment (without crop), among them castor intercropped with methi. It was due to latent heat of evapo-transpiration of crops. Relative humidity was found maximum at primary spike maturity stage as there was maximum leaf area which leads to higher relative humidity.

Interception of photo-synthetically active radiation was measured (MJm^{-2}day^{-1}) and presented Table 3, which reveals that interception photo-synthetically active radiation was maximum at 50% flowering stage and decreasing trend continues towards maturity stage irrespective of treatments imposed.

North-south oriented rows found as more efficient in intercepting photo-synthetically active radiation over East-west orientation. Similar finding was reported by Sandhu *et al*. (2012) and Mamun (2006) [3]. Sandhu *et al*. (2012) concluded that radiation interception was 10% more in N-S direction as compared to E-W sown crop. Data depicts that wider the crop rows, more will be the PAR interception. It was recorded that photo-synthetically active radiation interception was highest in control treatment (without crop) over cropping treatments. Hashan and Hamid (1994) [2]. found that penetration of PAR in plant canopy increased with increase in population density, which is relevant to findings made in this experiment that more penetration of PAR was observed in closer row spaced crop rows recorded higher PAR interception. PAR interception was more in intercropping over sole cropping. Same was reported by Ong *et al*. (1991) [4].

2. Analysing the relationship between microclimate and growth and yield

The relation of microclimate parameters and growth and yield parameters was presented in the form of correlation coefficient and same has presented in tables 4 to table 6. Air temperature at 50% flowering stage and capsule formation stage was positively correlated but at primary spike maturity stage was negatively correlated with growth and yield parameters. Among various parameters, plant height, test weight and yield were negatively correlated with air temperature at all growth stages. Lesser in test weight and yield may be due to more of maintenance respiration under higher air temperature. Relative humidity was negatively correlated with growth and yield parameters at 50% flowering stage but it was somewhat during primary spike maturity stage. All parameters are negatively correlated with relative humidity except plant height and test weight. Higher relative humidity during towards maturity was found favorable because of lesser energy spent on transpiration. There was positive correlation between PAR with growth and yield parameters at all the growth stages but it is negative correlation found for pant height at all the stages.

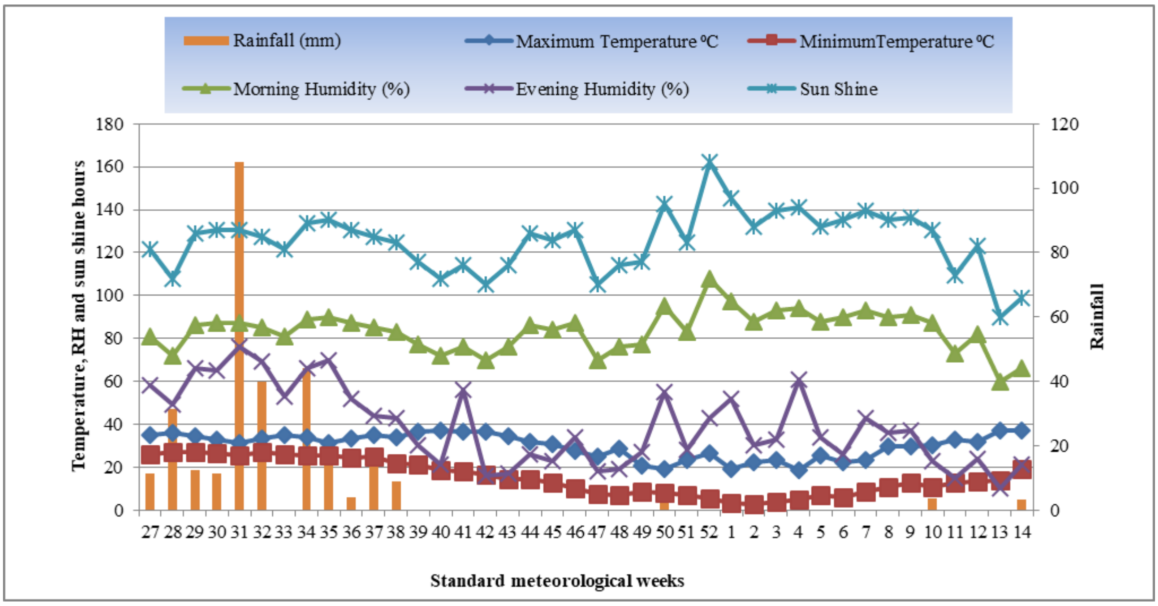

Fig 1: Weekly meteorological data recorded in Agro- meteorology observatory at Bawal from July 2017 to April 2018

Table 1: Variation in the air temperature with growth stages

Treatments	Growth stages		
	50% Flowering	**Capsule formation stage**	**Primary spike maturity stage**
Row direction			
East-west	35.10 (0.53)	33.12 (0.41)	20.80 (0.34)
North-south	35.50 (0.13)	33.70 (0.22)	21.22 (0.08)
Row spacing			
180 cm	35.49 (0.14)	33.31 (0.22)	21.01 (0.13)
240 cm	36.73 (1.10)	34.56 (1.03)	21.86 (0.72)
Cropping system			
Sole castor	35.45 (0.18)	33.25 (0.28)	21.00 (0.14)
Castor + Mungbean	35.10 (0.53)	33.20 (0.33)	20.90 (0.24)
Castor + Fenugreek	35.52 (0.11)	33.40 (0.13)	21.07 (0.07)
Control	36.17 (0.54)	33.73 (0.20)	21.23 (0.09)
Mean	35.63	33.53	21.14

Values in parentheses indicate standard deviation

Table 2: Variation in the relative humidity with growth stages

Treatments	Growth stages		
	50% Flowering	**Capsule formation stage**	**Primary spike maturity stage**
Row direction			
East-west	39.28 (0.49)	40.10 (0.71)	42.30 (0.98)
North-south	38.70 (0.09)	39.27 (0.12)	41.50 (0.18)
Row spacing			
180 cm	39.00 (0.21)	39.15 (0.24)	40.50 (0.18)
240 cm	38..50 (0.29)	39.00 (0.39)	40.22 (0.10)
Cropping system			
Sole castor	38.50 (0.29)	39.10 (0..29)	40.22 (0.10)
Castor + Mungbean	39.33 (0.54)	39.82 (0.43)	40.30 (0.02)
Castor + Fenugreek	38.90 (0.11)	39.70 (0.31)	40.25 (0.07)
Control	38.10 (0.69)	39.00 (0.39)	39.30 (1.02)
Mean	38.9	39.4	40.9

Values in parentheses indicate standard deviation

Table 3: variation in the PAR with growth stages

Treatment	Growth stages		
	50% Flowering	**Capsule formation stage**	**Primary spike maturity stage**
Row direction			
East-west	13.6 (0.20)	11.1 (0.50)	9.2 (0.70)
North-south	14.1 (0.30)	11.9 (0.30)	10.3 (0.40)
Row spacing			
180cm	13.7 (0.10)	11.6 (0.00)	9.8 (0.10)
240cm	14.1 (0.30)	12.3 (0.70)	10.7 (0.80)
Cropping system			

Sole castor	13.9 (0.10)	11.2 (0.40)	9.7 (0.20)
Castor + Mungbean	13.1 (0.70)	10.8 (0.80)	9.1 (0.80)
Castor + Fenugreek	13.7 (0.10)	11.6 (0.00)	9.6 (0.30)
Control	14.3 (0.50)	12.6 (1.00)	11.0 (1.07)
Mean	13.8	11.6	9.9

Values in parentheses indicate standard deviation

Table 4: Correlation between air temperature inside canopy at different growth stages with growth and yield parameters

Parameters	**Growth stages**		
	50% Flowering	**Capsule formation stage**	**Primary spike maturity stage**
Plant height	-0.54	-0.69	-0.65
Dry matter	0.65	0.62	-0.65
No. of branches per plant	0.51	0.42	0.47
No. spikes per plant	0.40	0.27	0.30
No. of capsules per spike	0.71	0.74	0.75*
Test weight	-0.16	-0.28	-0.22
Yield	-0.45	-0.45	-0.44

*Indicates significance at 5% probability level

Table 5: Correlation between relative humidity at different growth stages with growth and yield parameters

Parameters	**Growth stages**		
	50% Flowering	**Capsule formation stage**	**Primary spike maturity stage**
Plant height	0.09	0.12	0.10
Dry matter	-0.59	-0.13	-0.01
No. of branches per plant	-0.90*	-0.58	-0.22
No. spikes per plant	-0.51	-0.09	0.21
No. of capsules per spike	-0.78*	-0.41	-0.30
Test weight	0.57	0.55	0.18
Yield	-0.24	-0.13	0.07

*Indicates significance at 5% probability level

Table 6: Correlation between photo-synthetically active radiation at different growth stages with growth and yield parameters

Parameters	**Growth stages**		
	50% Flowering	**Capsule formation stage**	**Primary spike maturity stage**
Plant height	-0.21	-0.24	-0.61
Dry matter	0.74	0.52	0.59
No. of branches	0.90*	0.74	0.63
No. spikes per plant	0.65	0.33	0.20
No. of capsules per spike	0.85*	0.76*	0.88*
Test weight	0.56	0.32	0.23
Yield	0.46	0.42	0.41

* Indicates significance at 5% probability level

References

1. Dhimmar SK, Raj VC. Effect on growth and yield of rabi castor in pulses intercropping under varying planting geometry. America-European Journal of Sustainable Agriculture. 2009; 3:448-451.
2. Hashan A, Hamid A. Canopy structure, light penetration and productivity of varieties of mungbean. AVRDC and ISPRD mungbean season. International Symposium of pulses research. New Delhi, India, 1994.
3. Mamun. Effect of East-west, North-south and bidirection of light distribution and productivity of rice (Mater dissertation, environmental science dept., Bangladesh Agricultural University, Mymensingh, Bangladesh, 2006.
4. Ong CK, Subrahmanyam P, Khan AAH, The microclimate and productivity of a groundnut/millet intercrop during the rainy season. Agricultural and Forest Meteorology. 1991; 56(1-2):49-66.
5. Pandey BP, Basnet KB, Bhatta MR, Sah SK, Thapa RB, Kandel TP. Effect of row spacing and direction of sowing on yield and yield attributing characters of wheat cultivated in Western Chitwan, Nepal. Agricultural Sciences. 2013; 4(07): 309.
6. Reddy BN, Raghavaiah CV, Padmavathi P. Fertilizer management in intercropping systems involving castor or sunflower under rainfed conditions. Journals of Oilseeds Research. 2008; 25(1):89-91.
7. Rosenberg NJ, Blad BL, Verma SB. Microclimate: the biological environment. John Wiley & Sons, 1983.
8. Sandhu SK, Dhaliwal LK. Crop geometry effects on relative humidity variation within wheat crop. Asian Journal of Environmental Science. 2016; 11(1):94-101.
9. Yang WP, Guo TC, Liu SB, Wang CY, Wang YH, Ma D Y. Effects of row spacing in winter wheat on canopy structure and microclimate in later growth stage. Chinese Journal of Plant Ecology. 2008; 32(2):485-490.