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Research Article

Effect of Planting Geometry on Microclimate, Growth and Yield of Mungbean (*Vigna radiata* L.)

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ABSTRACT

An attempt was made to investigate the effect of planting geometry on the microclimate, growth and yield of mungbean. The study revealed that soil temperature was slightly higher in the crop grown in N-S direction as compared to the E-W sown crop. However, heat use efficiency was at par in the canopy of both row direction of sowing/the crop sown in the last week of July exhibited 4 % more PAR as compared to the crop sown in first week of August. Radiation interception was 10 per cent more in the crop sown in N-S direction as compared to E-W sown crop. The yield and yield attribute were found in the higher proportion in end July sown crop with 45 cm spacing in NS direction.

Key words: Mungbean, Microclimate, Plant geometry, Yield, Yield attributes

Introduction

Mungbean (*Vigna radiata* L.) is an important pulse crop of *kharif* season in India. It is highly sensitive to environmental fluctuation. The optimum sowing time ensures the complete harmony between the vegetative and reproductive phases on one hand and the climatic rhythm on the other and help in realizing the potential yield (Singh and Dhingra, 1993). The climate change and global warming has deleterious effects on crop production in terms of period of maturity and yield. Therefore, for sustainable production, it is an important aspect to make Indian agriculture more resilient to climate change by devising efficient strategies for crop production. We need to identify and develop new varieties of crops especially thermal resistant and alternate cropping patterns capable of withstanding extremes of weather. Agriculture will need to be progressively adapted to future climate and research system should be oriented to monitor and evaluate climate change and develop adaptive technologies for sustainable crop production with changes in agricultural practices such as manipulation of dates of sowing, row orientations to increase or reduce the radiation, heat or input use efficiencies, plant spacing etc.

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Material and Methods

The experiment was conducted during 2009-10 crop season at the Research Farm of Department of Agricultural Meteorology; PAU Ludhiana (30°54′ N, latitude and 74°48′ E longitude and altitude of 247 m above the mean sea level). The experiment was laid out in the split plot design and replicated thrice. The crop was sown on two different dates (last week of July and first week of August) with two row orientations *viz.* North-South (NS) and East –West (EW) and two spacing of 30×15 (P_1) and

45×15cm (P_2).The soil temperatures were recorded in each treatment separately with standard soil thermometers. Phenology and growth parameters were observed regularly during the crop growth cycle. The photosynthetically active radiation (PAR) was recorded using line quantum sensor in all the treatments. Yield and yield attributes were recorded at the harvest of crop.

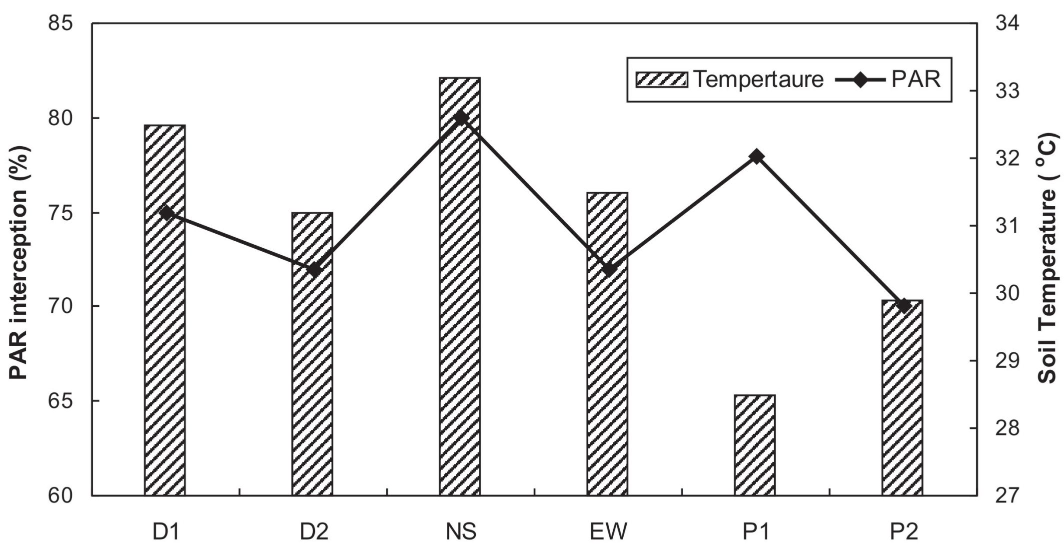
Results and Discussion

Microclimate of the Crop

The soil temperatures in the rows in N-S direction were slightly higher due to efficient penetration of radiation in the rows as compared to E-W sown crop where the shading effect was caused on the crop plants. The study revealed that crop sown in the end of the July intercepted on an average 4 per cent more radiation than when it was sown on August 1. Similarly, north - south direction sown crop was found to absorb 10 per cent more radiation than its counterpart east – west sown. The planting density of the crop was differed in terms of PAR interception. The widely sown crop intercepted 12 percent less radiation than densely sown crop. This may be due to the fact that in sparsely sown crop higher proportion of radiation transmitted to the soil. However, Hashan and Hamid (1994) found that penetration of PAR in the plant canopy increased with increase in population density.

Effect of Sowing Environment, Planting Geometry and Row Spacing on Yield and Yield Attributes

Plant height differed significantly with sowing environment and plant geometry and plant spacing. The plant height was more (61.8 cm) in the crop sown in last week of July as compared to the crop sown in first week of August (Table 1). Similarly N-S sown crop exhibited more (60 cm) plant height than E-W sown crop (55.0 cm).The closely spaced (30 X15 cm) crop was reported to have more plant height than sparsely sown crop. This may be due to the reason that the sparsely sown crop spreads more than the closely spaced which tends to grow in up right direction. However, Mathur et al (2007) observed significant increase in the height due to wider spacing of 45 cm over 30 cm. Significant differences were observed between the branches per plant in the crop sown with variable environment, direction of sowing and spacing (Table 1). Sekhon *et al*. (2002) observed that



D1 : Last week of July, D2 : First week of August
NS: North- south, EW: East –West, P1: 30x15cm, P2:45x15cm

Fig. 1. Effect of different treatments on microclimate of mungbean

Table 1. Growth attribute of mungbean at varying dates of sowing, row direction and spacing

Treatment	Plant height (cm)	Branches/plant	Pod/plant	Seeds/plant	100 seed wt (g)
D_1	61.80	6.00	45.60	13.50	3.50
D_2	52.80	4.80	42.50	12.50	2.70
CD (P=0.5)	3.51	1.52	2.40	0.52	0.50
NS	60.00	5.80	44.00	14.80	3.40
EW	55.00	4.50	40.10	13.80	3.20
CD (P=0.5)	4.52	0.80	2.50	0.25	0.08
P_1	60.00	4.90	44.30	14.80	3.42
P_2	54.50	3.80	43.50	14.30	2.25
CD (P=0.5)	3.80	0.50	0.80	NS	0.40

D_1 : Last week of July, D_2 : First week of August
NS: North south, EW: East –West, P_1: 30x15cm, P_2:45x15cm

Table 2. Effect of different treatments on Heat Use Efficiency of mungbean

Treatment	Yield (kg/ha)	Heat units (day °C)	HUE (kg/ha/ day°C)
D_1	977.7	1493	0.67
D_2	838.9	1526	0.55
NS	912.5	1510	0.60
EW	904.2	1510	0.59
P_1	694.5	1510	0.46
P_2	922.2	1510	0.62

D_1 : Last week of July, D_2 : First week of August
NS: North south, EW: East –West, P_1: 30x15cm, P_2:45x15cm

population density did not affect the plant height while number of branches/plant, LAI and number of pods/plant was significantly affected. They further observed that the plant height remained unaffected by population density yet it tended to increase with increase in population. Singh *et al.* (2010) observed a linear decline in the plant height with delay in sowing. They further reported that with delay in sowing, the flowering and maturity periods were reduced in all the genotypes.

Variations in the pods per plant were also observed due to different dates of sowing, planting geometry and spacing. The pods per plant were in higher proportion in end July sown crop in N-S direction with closer spacings. The seeds per plant were more in end July sown crop with N-S direction. However, the differences were non- significant so far as the plant spacing in concerned.

The test weight (100 seed weight) also varied in all the treatments. July end sown crop was found to have more 100 seed weight (3.50 gm) in N-S direction (3.40 gm) and closer spacing (3.42 gm) than their counter parts August 1 sown crop with E-W direction under wide spacing, respectively. However, Mathur *et al.* (2007) observed that at wider spacing of 45cm seed per pod and 100 seed weight recorded an increase of 11.9 and 15.7 per cent, respectively in comparison to narrow spacing. They attributed it to the fact that comparatively higher wind speed and limited moisture availability during the pre-flowering and flowering stage resulted in more dropping of flowers at wider spacing.

Heat Units and Heat Use Efficiency of Mungbean

The days taken and the heat units required by the crop sown in end July were less than the crop sown on 1 August. Although the heat units were at par in the direction of sowing and spacing, the direction of the rows did not affect the heat use efficiency of the crop significantly. The heat use efficiency of the crop under N–S direction was 0.60 kg/ha/day °C which was at par with E-W directional sown crop. So far as the plant spacing is concerned the heat use efficiency was observed in the higher proportions (0.62 kg/ha/day °C) in the wider spacing (45cm×15cm) than in closer spacing (0.46 kg/ha/day °C) of 30×10cm (Table 2)

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