https://doi.org/10.51323/jiar.1.1.2018.11-17

Journal of Innovation in Applied Research
eISSN: 2581-4206

Received: 10 August 2018
Accepted: 20 September 2018
First Published: 30 October 2018

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ORIGINAL RESEARCH

Performance of Intercropping in Greengram (*Vigna radiata* L.) Varieties With Maize (*Zea mays* L.)

T. Singh*, D.P. Chaturvedi and Mohd Junaid Siddiqui

Abstract: A field experiment entitled "Performance of intercropping in greengram (*Vigna radiate* L.) varieties with maize (*Zea mays* L.)" was conducted at the instructional farm AKS University, Satna, during July to November 2015. The greengram variety SL-78 intercropped with maize produced the highest number of cluster (5.63/plant), pods (26.73/plant) as well as Test weight (55.33 g). On the other hand, Cv Anand grown with maize gave the poor performance in case of Test weight. The grain yield of greengram and maize was influenced significantly due to different intercropping treatments. Maize intercropped with SL-78 greengram resulted in significantly higher yield of Maize (52.80 q/ha) as well as greengram SL-78 (1.23q/ha) over all other intercropping treatments.

Keywords: Inter-Cropping; Greengram; Maize

1. Introduction

Mungbean (*Vigna radiata* L.) is primarily a rainy season crop. However, with the development of early maturing varieties it has also proved to be an ideal crop for spring season. Area, production and productivity of mungbean in India during 2015 is 25.82 ha, 15.92 tonn and 815 kg/ha respectively. The major pulse growing states are Madhya Pradesh, Rajasthan, Maharashtra, UP and AP which together account for 82 percent of the production from an area of about 74 percent [Dashora *et al.,* 2000]. Globally pulses are second in importance only to cereals. Pulses occupy 68.32-million-hectare area and contribute 57.71 million tonnes to the world food. [Tuteja, 2006]. India is the largest producer and consumer of pulses in the world accounting for 35.2 % area and 27.65 % of the global production. The production of pulses reached to its highest of 14.91 million tonnes during 1999 (Agriculture situation in India, 2001). During 2013-2014, area of pulses 252.27 lakh hectare, pulses production 19.27 million tonnes and productivity yield 764 kg/ha. Essentially of rice and wheat vis-a-vis urgency of increasing pulses production calls for a paradigm shift in crop planning with major attention on diversification of cropping system involving pulses (Lawwa and kumar, 2008).

Among all the pulses greengram is one of the most important kharif pulse crop of rainfed areas grown mainly under different intercropping system in rainfed conditions. Traditionally, greengram is grown in the kharif season as a sole crop as well as mixed crop with sorghum, maize, bajra and cotton. The intercropping has been recently introduced to raise the productivity and fertility per unit area with greengram.

2. Materials and Methods

The soil of the experimental field was having pH 7.5, organic carbon 0.40%, electrical conductivity 0.160 dS/m, available N, P_2O_5 and K_2O 176.5,11.5and 180.00 kg/ha, respectively. The total rainfall received during the crop season was 650 mm. The treatments comprised ten varieties of greengram intercropped with maize var. Shaktiman-2 each at 1:1 row ratio. The ten greengram varieties were Samrat, SL-78, K-851, Pusa vishal, Anand, Varsha, Narendra moong-1, Ganga-8, RUM-1 and Pusa 0672. The greengram and maize were sown on 25nd July, 2015 at the seed rate of 20 and 25 kg/ha, respectively. The fertilizer dose of greengram was N_{20} P_{40} K_{20} and for maize N_{80} P_{50} K_{30}. The crops were harvested on Greengram 5th October and 1st November 2015.

3. Results and Discussion

3.1. Plant Height

The plant height was found to increase with the advancement of age of all the greengram varieties up to at harvest in observation. The height of all the varieties of greengram was found to increase rapidly between 30 and 45 days after sowing. The rapid increase in plant height at this active vegetative growth stage may be attributed to the increase number of leaves i.e. photosynthetic area thus manufacturing increase food for growth. The statistical analysis of plant height recorded at different stages of plant growth indicates that the response of varieties deviated significantly. The overall picture reveals that the greengram variety SL-78 intercropped with Maize (Maize + SL -78) remained aggressive in attaining its height up to the higher range throughout the growth period (30 to At harvest) as compared to remaing greengram varieties. This was, however followed by Narendra moong-1 and Pusa vishal varieties intercropped with Maize (Maize+ Narendra moong-1 and Maize + Pusa vishal). These results are in close conformity with the finding of Gupta and LaL (1989), Khandait and Singh (1989), Halvankar *et al.* (1993) and Shafshak (1998).

3.2. Leaves per Plant

The greengram varieties (Maize + SL-78) and (Maize + Narendra moong-1) resulted significantly higher leaf count (11.20 to 11.00 leaves/plant) as compared to Pusa vishal, K-851, Samrat, Anand varieties of greengram grown with maize. The means, Maize + Varsha, Maize + Ganga -8 and same treatment Maize+RUM-8, Maize + Pusa 0672 greengram varieties were at par with those of Maize+SL-78 and Maize + Narendra moong -1 varieties of greengram. The wide differences in the formation of leaves per plant among the greengram varieties may be due to the variation in their genetic build up transmitted during the varietal improvement processes.The different greengram varieties differed in their leaves formation (leaf count per plant) has also been reported by many workers (khandait and Singh, 1989, Sajjan and Soni, 1989, Chiezey *et al.,*1993).

3.3. Branches per Plant

The variety SL-78 of greengram intercropped with maize resulted in significantly higher number of branches (3.70 /plant) over Narendra moong-1, Pusa vishal varieties of greengram grown with maize. The remaining intercropped greengram varieties including SL-78 were found to be identical to each other in this respect giving the increased number of branches i.e. 3.67 to 3.70 per plant. This may be due to variability in the varietal inheritance among the greengram varieties. The similar results was also observed by Rana and Ahuja (1986) and Gupta and Lal (1989).

3.4. Fresh Weight per Plant

The examination of data in Table 4 indicates that the fresh weight per plant of all the greengram varieties, in general, produced very fast (by multi-fold) between 30- and 45-days growth period. The response of greengram varieties intercropped with maize was found to be significant at all the observation dates i.e., 30 and 45 days after sowing. The greengram variety SL-78 grown with maize (Maize+ SL-78) resulted in the maximum fresh weight per plant at each stage of observation. at 45 days stage, this intercropping treatment produced significantly higher dry weight (22.23 g/plant) over all the remaining intercropping treatments. In contrast to this, Maize + Narendra moong-1 and Maize+ Anand greengram varieties resulted in significantly lowest dry weight per plant at 45 days stages (22.13 to 22.23 g/plant). This may be due to genetical variation in overall growth and development of the individual greengram varieties as it is also evident from the other growth observations like plant height, branches and leaves per plant. This indicated the differential photosynthetic activities in different greengram varieties under test.

3.5. Dry Weight per Plant

The greengram variety SL-78 grown with maize (Maize+SL-78) resulted in the maximum dry weight per plant at each stage of observation. at 45 days stage, this intercropping treatment produced significantly higher dry weight (10.27 g/plant) over all the remaining intercropping treatments. In contrast to this, Maize + Narendra moong-1 and Maize + Pusavishal greengram varieties resulted in significantly lowest dry weight per plant at 45 days stages (9.90 to 9.89 g/plant). This may be due to genetical variation in overall growth and development of the individual greengram varieties as it is also evident from the other growth observations like plant height, branches and leaves per plant. This indicated the differential photosynthetic activities in different greengram varieties under test. The significant variation in the varietal response in respect of dry matter accumulation was also reported by Sarathe and Singh, 1983; Vyas and Soni, 1984; Rana and Ahuja, 1986.

3.6. Number of Cluster per Plant

The number of clusters per plant is one of the important yield-attributing characters of the crop plants. It was deviated significantly in case of greengram varieties intercropped with maize. The greengram variety SL-78 intercropped with Maize produced the maximum cluster (5.63 cluster/-plant), closely followed by Maize + Narendra moong-1 greengram variety (5.33 cluster/plant), Maize + Pusa vishal (5.20 cluster/plant), Maize + Varsha (5.18 cluster/plant). The best treatment Maize + SL-78 significant higher cluster (5.63 cluster/plant). The lowest 4.12 cluster /plant were noted in case of RUM-8 variety of greengram grown with maize. The significant differences in production of cluster per plant among the greengram varieties may be due to variations in their genetic build up for this character.

3.7. Number of Pods per Plant

The number of pods/plants is one of the important yield-attributing characters of the crop plantsIt was deviated significantly in case of greengram varieties intercropped with maize. The greengram variety SL-78 intercropped with Maize produced the maximum pods 26.73 pods/-plant, closely followed by Maize + Narendra moong-1greengram variety 26.17 pods/plant, Maize + Pusa vishal 25.60 pods/plant, Maize + Ganga-8 25.57 pods/plant and same treatment Maize +RUM-8, Maize + Pusa 0672 25.53 pods /plant. The lowest 24.52 pods/plant were noted in case of Samrat variety of greengram grown with maize. The significant differences in production of cluster per plant among the greengram varieties may be due to variations in their genetic build up for this character. These results corroborate with those of Sharma and Singh (1985), Pawar and Sirohi (1987), Sajjan and Soni (1989), Verma *et al.* (1998) and Panchariya and lidder (2000).

3.8. Test Weight (g)

This yield-attributing parameter was influenced significantly due to different maize plus greengram varieties intercropping treatments. Among these treatments, Maize + SL-78 variety resulted significantly higher test weight up to (55.33 g) over all other varietal treatments except Maize + Narendra moong treatment (54.33 g). Thus, the treatment Maize + Narendra moong -1 proved the second best in raising the test weight of greengram, followed by Maize + Pusa visal (54 g) and then Maize +K-851 (53g), Maize +Varsha (51.67 g). The lowest test weight Maize + Anand (47 g). Thus indicates the fact that the size of the grain produced by the different greengram varieties was variable and the variety which gave the maximum test weight evidently showing the bigger size grain quality in addition to its contribution upon grain per hectare. Similar resuls have also been reported by Vyas and Soni (1984) and Lidder (2000), Singh (2000) and Singh *et al,* (2005).

3.9. Grain Yield g and q/Ha

The intercropping treatment Maize + SL-78 variety of greengram registered the significantly higher yield of maize (6336.83 g,52.80 q/ha) over all the other intercropping treatments except Maize + Narendra moong-1, Maize + Pusavishal. The grain yield of green yield of greengram was also significantly higher due to the same intercropping treatment. Maize + SL-78 giving overall the remaining treatments. In contrast to this, the lower maize yield was recorded in case of Maize + Ganga and Maize + Samrat treatments, whereas the lowest greengram yield only 135.17g, 1.13 q/ha was obtained in case of Maize + Samrat intercropping treatment. The Maize + Samrat variety of greengram also recorded the lower yield of maize as compared to most of the other greengram varieties intercropped with maize.The higher greengram yield in case of SL-78 variety may be due to the sum total effect of enhanced growth and yield-attributing characters inherited in this variety. The higher maize yield intercropped with SL-78 greengram variety may be attributed to the overall synergistic influence of this variety upon maize grown at 1:1 row ratio. The present findings corroborate with those of Solaimalai and Muthusankaranarayana (2000), Singh (2000), Ram and Singh (2002), Rashid and Himayatullah (2003) and Singh *et al.* (2005).

[Table 1 about here.]

4. Conclusion

Present comparative investigations reveal that developed nanocomposite polymer electrolyte nanofibers containing MWNT nanofiller is the best ion conducting system having better morphology and high ionic conductivity. Enhanced amorphous behavior is revealed in case of fiber mats from XRD studies of NCPEs systems-based gel films and its corresponding fiber mats. DSC results of fiber mats show higher thermal stability as compared to corresponding gel electrolyte films. Bulk conductivity data shows best response for fiber mats. Cyclic Voltammetric investigations on fibers mats have shown that better electrochemical stability viz. -2V to +1.7V. Current examinations thus suggest electrospinning of fiber mats of nanocomposite polymer gel electrolyte as a suitable technique of achieving thermally, electrochemically and mechanically stable electrolytes with ion conductivity properties approaching that of liquid electrolyte. Such properties are expected to open up new application areas particularly in electrochemical devices.

5. Acknowledgement

The author wishes to acknowledge to AMPRI (CSIR) Bhopal for providing DSC measurement facility and Department of Physics, IIT Madras for providing electrospinning setup. I also would like to thanks Prof. S. L. Agrawal, APS University, Rewa for giving facility to perform electrochemical measurements.

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Citation information

Cite this article as: Singh, T., Chaturvedi, D., & Junaid Siddiqui, M. (2018). Performance of Intercropping in Greengram (Vigna radiata L.) Varieties With Maize (Zea mays L.). *Journal of Innovation in Applied Research, 1*, Article 02. doi: 10.51323/jiar.1.1.2018.11-17

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https://doi.org/10.51323/jiar.1.1.2018.11-17

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Table 1. Plant height (cm)/plant, Leaves /plant, Branches/ plant and Fresh weight (g) of greengram as influenced by different treatments

Maize + Greengram intercropping	Plant height (cm)			Leaves per plant			Number of Branches per plant			Fresh weight (g)	
	30 DAYS	45 DAYS	At Harvest	30 DAYS	45 DAYS	At Harvest	30 DAYS	45 DAYS	At Harvest	30 DAYS	45 DAYS
M + SAMRAT	25.61	33.07	38.17	6.30	9.33	9.60	2.77	3.47	3.59	8.24	21.26
M + SL-78	27.51	37.02	39.83	7.67	10.80	11.20	3.53	3.67	3.70	8.65	22.23
M + K-851	22.25	32.51	36.67	6.33	9.93	10.07	3.07	3.20	3.28	8.22	20.35
M + PUSA VISHAL	26.53	35.48	39.33	6.53	10.20	10.67	3.27	3.60	3.68	8.60	22.03
M + ANAND	23.18	29.90	36.17	6.20	8.40	9.47	2.80	3.57	3.62	8.07	22.23
M + VARSHA	22.45	32.37	34.67	5.87	8.27	8.60	3.20	3.27	3.33	8.43	20.81
M+NARENDRA MOONG-1	27.03	36.22	39.50	7.13	10.67	11.00	3.47	3.63	3.69	8.62	22.13
M + GANGA -8	25.02	29.25	38.67	6.23	8.07	8.40	2.23	2.37	3.27	7.73	21.93
M + RUM-8	24.16	34.58	36.08	6.17	7.60	8.47	2.67	2.93	3.07	8.18	20.17
M + PUSA-0672	23.42	34.58	36.08	6.10	7.60	8.47	2.90	2.93	3.07	8.42	20.15
S. Ed.(±)	1.635	2.278	1.55	0.414	0.881	0.732	0.338	0.316	0.198	0.246	0.684
C. D.(P=0.05)	3.374	4.702	3.198	0.854	1.818	1.511	0.697	0.652	0.408	0.507	1.411