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Performance of greengram (*Vigna radiata* L.) varieties under different tillage practices in central plain zone of Uttar Pradesh

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Abstract
A field experiment was conducted at students' Instructional Farm, Department if Agronomy. Chandra Shekhar Azad University of Agriculture and Technology Kanpur (U.P) in *summer* season for two consecutive years (2019 and 2020) with the objective to study the response of selected greengram varieties under different tillage practices and to identify the most suitable tillage and varieties combination. Split plot design was adopted with three replication. The main plot treatments were two practices of tillage *viz.*, zero and conventional tillage. The sub plot treatments were three varieties PDM 139, IPM 205-07 and IPM 99-125. The study revealed that tillage practices and varieties had influence on growth, yield and quality of greengram. Mean growth parameter and yield was significantly not influenced by tillage practices in both of years of investigation. However, conventional tillage was higher growth and yield attributed as compared to zero tillage. But while growth, yield attributed was found significantly influenced by varieties in the both years of investigation. The crop growth rate, relative growth rate and net assimilation rate were higher under with variety IPM 99-125 and was followed by variety PDM 139. Root length, root dry matter plant^{-1} and number of functional root nodule plant^{-1} were observed with variety IPM 99-125 as compared to variety IPM 205-07 and variety PDM 139. Variety IPM 205-07 was found significantly higher percent of soil moisture as compared other variety treatments.

Keywords: Tillage, varieties, crop growth rate, relative growth rate, net assimilation rate root dry matter, functional root nodule, chlorophyll intensity, soil moisture and availability of nutrient

Introduction
Pulse crops are primarily grown under rain fed condition and a low fertility neglected soil in India. It can be grown on a variety of soil and climatic conditions as it is tolerant to drought. Mungbean in India is mainly grown either as a subsistence monocrop or intercrop during *kharif* season. Nevertheless, with increased irrigation facilities through new irrigation projects, remunerative prices and availability of short duration cultivars, this crop now occupies considerable area during summer season also in several parts of India. Greengram has also picked up substantial area in summer due to development of new cultivars with shorter maturity duration (60-65 days), high yield (1.0 -1.5 tonnes ha^{-1}), photo-thermo insensitivity, synchronous and resistance to YMV. (Gupta and Pratap, 2016) [5]. Conventional tillage practices, involving cultivator followed by a rotavator for seed-bed preparation, further delay the sowing about 7–10 days. Mechanical manipulation of the soil resulted in fine seed bed, get rid of weeds and to decrease the leaching and percolation losses for the better land productivity but on the long run it was observed to have negative effects on the soil properties, structure and finally to the environment. Resource conserving technology (RCTs) like zero tillage and residue retention have emerged over the past 2-3 decades as a means of achieving the sustainability of intensive cropping system (Sharma *et al.* 2012) [1] In addition to reduction in the cost of cultivation and getting stable yield conservation agriculture practices also improve soil fertility through increased carbon accumulation & biological activity, reduce energy input. Resource –conserving techniques, such as zero tillage have been developed for improving efficiency of water, nutrients in crop plant. Improved varieties of greengram hold promise to increase productivity by 20-25%. The farmers are using cultivars, which have low yield potential and heavy incidence of YMV. One of the major constraint of poor yield and spread of greengram is the poor awareness about of suitable high yielding varieties to replace the traditional varieties Some studies indicated that conventional tillage was better for greengram

than zero tillage. However, the information in different tillage practices. Accordingly, a study was planned to evaluate the performance of different greengram varieties during different tillage practices.

Material and Method

The experiment was conducted in field number 8 at Students' Instructional Farm, Department of Agronomy of this University, which is situated in the alluvial tract of Indo - Gangetic plains in central part of Uttar Pradesh between 25° 26' to 26° 58' North latitude and 79° 31' to 80°34'East longitude at an elevation of 125.9 meters from the sea level. This region falls under agro-climatic zone V (Central Plain Zone) of Uttar Pradesh. The soil of the experimental field was sandy loamy texture, organic carbon (0.62 and 0.65%) and available nitrogen (211.20 and 213.75 kg ha^{-1}) medium available phosphorus (12.07 and 13.36 kg ha^{-1}) and available potash (250.76 and 260.72 kg ha^{-1}). Alkaline permanganate method, Olsen's calorimetrically method, Flame photometer method, Walkley and Black method for the determination of available Nitrogen, Phosphorus, Potassium organic carbon, respectively. The pH and EC experimental site was determined through Electrometric glass electrode method. The pH of experimental soil was 7.20, 7.19 and EC 0.318, 0.331 during both of investigation. Six treatments combinations comparing of two tillage practices *viz.*, zero tillage and conventional tillage and three varieties *viz.*, PDM 139, IPM 205-07 and IPM 99-125 were evaluated in split plot design with three replication by keeping tillage main plot and varieties sub plot. Size of gross pot was 5.5 m x 4.0 m. A fertilizer dose of 18, 46, 20 kg ha^{-1} through DAP (100 kg ha^{-1}) and muriate of potash (34 kg ha^{-1}) was given to all the treatment at the time of sowing in the furrow. All the culture practices were performed uniformly for all the treatments. Greengram varieties were dibbled on 18 April 2019 and 2020 using different seed rate as per treatments. Intercultural operations like weeding, mulching, irrigation and pest control practices. The crop was harvested at different date as par maturity of different varieties when 90% pods were matured. Observations on different growth and yield parameters were recorded from five randomly selected plants in each net plot and seed yield was recorded. Then harvested crop was properly dried in the sun before threshing. The data recorded were table and analyzed statistically using (ANOVA) technique and the treatment were compared at 5% level of significance.

Result and Discussion

1. Effect of tillage practices

An appraisal of the data presented in Table 1 indicated that growth of summer greengram was evaluated in terms of crop growth rate, relative growth rate, and net assimilation rate at successive stage. Tillage practices could not increased growth rate, relative growth rate and net assimilation rate significantly during both years and on pooled data basis. This could be due to crop performed equally well under zero and conventional tillage practices. Dodwadiya and Sharma (2012) [1] reported similar finding. Root length, root dry matter and number of functional root nodule $plant^{-1}$ were non-significantly influenced by tillage. However, conventional tillage better root growth and number of functional root nodule $plant^{-1}$ as compared to zero tillage. This might be due to good soil condition, minimum weed competition, soil depth which friable for better root growth. Similar result was reported by Suryavanshi *et al.*, (2018) [10].

The appraisal of data presented in Table 3 indicated that chlorophyll intensity was non-significantly influenced by tillage practices. However, conventional tillage enhanced more chlorophyll intensity as compared to zero tillage. This Might be due to friable soil condition, soil water absorption ratio, low weed density and soil aeration.

The appraisal of data presented in Table 3 indicated soil moisture percentage was non-significantly influenced by tillage practices. However, conventional tillage enhanced more soil moisture percentage as compared to zero tillage. This might be due to difference observed the soil aeration, soil higher water absorption, lower weed population, soil infiltration rate.

Table 1: Growth parameters of summer greengram by different tillage practices and varieties

Treatments	Crop growth rate (gm^{-2} day^{-1}) 25 DAS			Relative growth rate (gg day^{-1}) 25 DAS			Net assimilation rate 25 DAS		
	2019	2020	Pooled	2019	2020	Pooled	2019	2020	Pooled
Tillage									
Zero tillage	16.54	15.58	16.67	0.0357	0.0352	0.0352	0.0507	0.0500	0.0503
Conventional tillage	16.76	16.81	16.68	0.0366	0.0364	0.0364	0.0552	0.0548	0.0548
S.Em. ±	0.093	0.041	0.030	0.0000	0.0000	0.0000	0.0010	0.0000	0.0000
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS
Varieties									
PDM 139	16.39	16.47	16.48	0.0398	0.0396	0.0395	0.0572	0.0572	0.0572
IPM 205-07	16.34	14.94	16.35	0.0283	0.0282	0.0282	0.0417	0.0417	0.0417
IPM 99-125	17.22	17.18	17.20	0.0400	0.0397	0.0397	0.0600	0.0583	0.0588
S.Em. ±	0.080	0.118	0.069	0.0000	0.0000	0.0000	0.0010	0.0010	0.0000
CD at 5%	0.260	0.383	0.223	0.0010	0.0010	0.0010	0.0030	0.0020	0.0010

Table 2: Growth parameters of summer greengram by different tillage practices and varieties.

Treatments	Root length (cm)			Root dry matter plant^{-1} (g)			Number of functional root nodule plant^{-1}		
	2019	2020	Pooled	2019	2020	Pooled	2019	2020	Pooled
Tillage									
Zero tillage	25.33	25.55	25.44	1.15	1.17	1.15	23.37	24.33	23.85
Conventional tillage	25.33	25.55	25.44	1.15	1.17	1.16	23.91	24.88	24.43
S.Em. ±	0.057	0.205	0.103	0.006	0.007	0.005	0.031	0.257	0.018
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS
Varieties									
PDM 139	24.92	25.14	25.03	2.15	2.17	2.16	24.02	24.87	24.44
IPM 205-07	23.76	23.97	23.87	1.14	1.16	1.15	22.79	22.84	22.81
IPM 99-125	26.31	26.54	26.43	2.16	2.18	2.17	24.12	25.11	24.61
S.Em. ±	0.157	0.230	0.103	0.10	0.20	0.10	0.146	0.227	0.081
CD at 5%	0.511	0.750	0.337	0.040	0.050	0.020	0.475	0.738	0.263

2. Effect of varieties

The appraisal of data presented in table 1 indicated that variety IPM 99-125 significantly increased the growth parameter *viz*. CGR, RGR and NAR at different growth stage of plant. It was significantly super over variety IPM 205-07 and PDM 139. This might be due to IPM 99-125 as evidenced by higher plant height, number of branches, leaf area index over IPM 205-07 and PDM 139. The increased growth ultimately results in higher value of CGR, RGR and NAR. Similar results were reported by Mondal. R. and Sengupta K. (2019) [2]. Root length, root dry matter plant^{-1} and number of functional root nodule plant^{-1} were observed maximum with variety IPM 99-125 as compared to variety IPM 205-07 and PDM 139. Variation observed among the varieties was due to inherent character of particular variety and also genetically, environmental factor. Similar result was reported by Pegu *et al.*, (2016) [4] and Patel *et al.*, (2020) [3] Significantly maximum soil moisture content was registered with variety IPM 205-07 as compared to variety IPM 99-125 and PDM 139 at successive of crop. This variation may attribute to variety characteristics *viz.* plant height, leaf size, transpiration rate and environmental factor and soil condition.

The appraisal of data presented in table 3 indicated that maximum chlorophyll intensity was observed with variety IPM 99-125 as compared to IPM 205-07 and PDM 139. Higher variety chlorophyll intensity may be attributed to variety characters *viz.* plant height, leaves area, photosynthetic rate, stomata variation. Similar result was reported by Pegu *et al.*, (2016) [4].

Variety IPM 205-07 established superiority over other varieties PDM 139 and IPM 99-125 with respect to grain yield and yield attributes character *viz.* no. of pod plant^{-1}, pod length, no. of seed pod^{-1}, seed weight and test weight. It may be attributed to special qualities credited to variety including, disease resistance, early maturity, uniformity flowering, early flowering and short duration. This is similar to finding of Shersingh *et al.*, (2016) [6] and Patel *et al.*, (2020) [3]. Straw and biological yield was observed with variety IPM 99-125 as compared to varieties PDM 139 and IPM 205-07. This might be due to genetic makeup of plant, internal morphological character, insect and disease resistance which caused plant to take up more nutrients from the soil resulting in maximum growth parameter and yield attributes. Similar result was reported by Patel *et al.*, (2020) [3] and Shersingh *et al.*, (2016) [6].

Maximum availability of nutrient N, P and K was registered with variety IPM 205-07 as compared to PDM 139 and IPM 99-125. This might be due to genetic makeup of greengram varieties like plant height, duration of crop and nutrient availability of plant from soil. Because of short duration variety not used much large nutrient from soil. Similar result were reported by Patel *et al.*, (2020) [3] and Mondal. R. and Sengupta K. (2019) [2].

Table 3: Growth and soil moisture parameters of summer greengram by different tillage practices and varieties.

Treatments	Soil moisture (%) At harvest			Chlorophyll intensity (%) 25 DAS			Chlorophyll intensity (%) 50 DAS		
	2019	2020	Pooled	2019	2020	Pooled	2019	2020	Pooled
Tillage									
Zero tillage	8.97	11.00	9.98	31.43	31.66	31.55	49.90	51.03	50.46
Conventional tillage	9.86	11.92	10.89	32.54	32.75	32.64	51.41	52.58	51.99
S.Em. ±	0.011	0.036	0.035	0.122	0.076	0.250	0.230	0.288	0.336
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS
Varieties									
PDM 139	9.15	11.19	10.17	31.59	31.81	31.70	49.15	50.12	49.64
IPM 205-07	10.14	11.99	11.06	30.72	30.93	30.83	47.74	48.96	48.35
IPM 99-125	8.95	11.21	10.08	33.65	33.87	33.76	55.07	56.33	55.70
S.Em. ±	0.027	0.038	0.035	0.126	0.201	0.285	0.228	0.431	0.449
CD at 5%	0.087	0.124	0.114	0.412	0.653	0.927	0.741	1.403	1.463

Table 4: Nutrient available in soil of summer greengram by different tillage practices and varieties.

Nutrient available in soil (kg ha^{-1})									
	N			P			K		
Treatments	**2019**	**2020**	**Pooled**	**2019**	**2020**	**Pooled**	**2019**	**2020**	**Pooled**
Tillage									
Zero tillage	212.41	214.66	213.50	11.12	12.29	11.71	252.91	254.53	253.72
Conventional tillage	210.47	212.62	211.53	12.39	13.46	12.93	255.00	256.99	256.00
S.Em. ±	0.486	0.557	0.336	0.076	0.054	0.047	3.208	1.868	0.942
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS
Varieties									
PDM 139	211.59	213.71	212.57	11.25	12.36	11.80	248.57	250.55	249.56
IPM 205-07	213.42	215.75	214.59	12.97	14.02	13.49	266.11	267.58	266.85
IPM 99-125	209.31	211.46	210.39	11.04	12.26	11.65	247.19	249.16	248.17
S.Em. ±	0.479	0.483	0.397	0.065	0.060	0.068	2.022	2.060	2.097
CD at 5%	1.561	1.574	1.294	0.212	0.196	0.220	6.585	6.710	6.831

Conclusion

It can conclude that summer greengram varieties grown under different tillage practices in summer season. Tillage practices were found non-significant effect. But while, on the basis of data observed that which was found maximum higher value obtained with convention tillage practices as comparison to zero tillage in both of investigation and on pooled basis. Variety considering maximum growth parameter was a found with variety IPM 99-125 as compared to IPM 205-07 and PDM 139 during both years of investigation.

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