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Research Paper

Phenology, dry matter and yield of greengram (*Vigna radiata*) as influenced by planting methods and weed-management practices

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ABSTRACT

An experiment was carried out during the rainy (*kharif*) season of 2014 and 2015 at Hisar, Haryana, to find out suitable method of planting and weed management in greengram [*Vigna radiata* (L.) Wilczek]. There was no significant effect of planting methods and weed management practices on days taken to 75% emergence. Similarly, days to 50% flowering, 50% pod formation and physiological maturity were not affected by planting methods. However among weed-management practices, these parameters were significantly lesser in weedy check treatment as compared to remaining treatments. Total dry-matter accumulation in plant remained unaffected due to planting methods and weed-management practices at 15 days after sowing (DAS). However, at remaining stages of observation (30, 45 DAS and at maturity), statistically higher dry-matter accumulation in plant (4.17, 12.28 and 30.57 g/plant, respectively) was recorded in raised-bed method among the planting methods and in weed-free treatment (5.03, 14.23 and 34.49 g/plant, respectively) among the weed-management practices. Of the different planting methods and weed-management treatments, raised bed and hand-weeding (15 and 30 DAS), respectively, provided the highest weed-control efficiency (86.6%). Seed yield (8.5 q/ha), net returns (17.6×10^3 ₹/ha) and benefit: cost ratio (1.73) were maximum in the raised-bed method of planting. The maximum seed yield (1.11 t/ha) was found in weed-free treatment, but net returns (27.2×10^3/ha) and benefit: cost ratio (2.33) were the maximum in treatment having post-emergence application of imazethapyr @ 100 g/ha.

Key words **:** Dry matter, Greengram, Phenology, Planting methods, Weed management practices, Yield

Greengram [*Vigna radiata* (L.) Wilczek] is one of the major rainy (*kharif*) pulse crops in India, cultivated in arid and semi-arid region. It is an important and the third most widely cultivated pulse crop in India, next to chickpea and pigeonpea. In the *kharif* season, weeds are a serious problem due to favourable conditions for their growth.

Adequate tillage checks and delays the emergence of weeds and provides a more favourable environment for early crop establishment. Proper seedbed and land preparation are important for adequate germination of seed, crop establishment and good yields. Weed management is one of the important factors for enhancing productivity of greengram, as weeds compete for nutrients, water, light and space with crop plants during early growth period. Weeds above critical population thresholds can significantly reduce crop yield and quality. The full-season competition with weeds in greengram causes yield reduction to the extent of 25–100% (Malik *et al.,* 2005). No doubt, cultural as well as mechanical practices such as hand-weeding and interculture are effective but unavailability of labour and continuous rainfall in the rainy season does not permit to remove weeds timely. Chemical weed control is other option which is low priced and provides effective control of weeds. Hence an experiment was conducted to study the effect of planting methods and weed-management practices on phenology, dry-matter and yield of greengram.

MATERIALS AND METHODS

The experiment was conducted during the rainy (*kharif*) seasons of 2014 and 2015 at research farm, Department of Agronomy, Chaudhary Charan Singh Haryana Agricultural University, Hisar (29° 10´ N, 75° 46´ E 215.2 m above mean sea-level), Haryana in the sub-tropical zone. The experimental soil had *p*H 7.8 and was sandy loam in texture. The soil was medium in organic carbon (0.28%), having available nitrogen, phosphorus and potas-

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sium 160 kg/ha, 16 kg/ha and 342 kg/ha respectively. The design used for the experiment was split-plot with 3 planting methods as main plot treatment (raised bed, conventional and zero till) and 9 weed-management practices, viz. weedy check, hand-weeding at 15 and 30 days after sowing (DAS), weed-free, pendimethalin as pre-emergence (Pre) @ 1,000 g/ha, imazethapyr Pre @ 70 g/ha, imazethapyr Pre @ 100 g/ha, imazethapyr 3–4-leaf stage @ 70 g/ha, imazethapyr 3–4-leaf stage @ 100 g/ha, imazethapyr + imazamox (RM) 3–4-leaf stage @ 70 g/ha as subplot treatment.

During 2014, the field was ploughed in the last week of June by cross-harrowing followed by cultivator in plots where conventional tillage and raised-bed method of planting were to be practiced and then planking was done to bring fine tilth and no soil disturbance was done in plots where zero-till method of planting was done. Raised beds were prepared by bed-planter machine. Previously growing weeds present in plots where zero tillage was practised were killed by the application of glyphosate. During 2015, plots of conventional till planting method were prepared with the same operations as done in the previous year in the last week of June, while raised beds were kept as such and only their reshaping was done and no disturbance was done in plots where zero till planting method was done. Seed was sown on 30 June and 2 July during 2014 and 2015, respectively, using a seed rate of 20 kg/ha with the recommended dose of fertilizer by seed-cum-fertilizer drill and by bed planter on raised beds with 2 rows of greengram cultivar 'MH 421' on the bed (75 cm wide).

The emergence count was recorded from the different plots on daily basis from the date of first emergence till it was constant and thus, days taken to emergence were calculated from the date of sowing. From the date of first appearance of flower and pod, the field was observed every alternate day till full flowering and pod formation. The dates on which 50% flowering and 50% pod formation observed were recorded and then days were calculated. At physiological maturity, change in colour of pods from green to brown was observed and the date was recorded when 80% pods turned brown and accordingly days were counted. Total dry-matter accumulation/plant was worked out by adding the weight of leaves, stem (15, 30 DAS) and leaves, stem, pods (45 DAS and at maturity). Weed-control efficiency (WCE) was calculated from the mean data over 2 years by using formula:

$$WCE\ (\%) = (WDc - WDt)/WDc \times 100;$$

where WCE, weed-control efficiency; WDc, weed dry biomass (g/m^2) in the control plot; WDt, weed dry biomass (g/m^2) in treated plot.

From the recorded data of biological yield kg per plot, biological yield were computed as quintal/ha on multiplying the yield/plot by conversion factor. From the recorded data of seed yield kg/plot, seed yield were computed as quintal per hectare on multiplying the yield per plot by conversion factor.

RESULTS AND DISCUSSION

Phenological observations and dry-matter accumulation

There was no significant effect of planting methods and weed-management practices on days taken to 75% emergence. Similarly, days to 50% flowering, 50% pod formation and physiological maturity were not affected by the planting methods in both the years (Table 1). Among the weed-management practices, days to 50% flowering, 50% pod formation and physiological maturity were significantly lesser in weedy check treatment as compared to the remaining treatments, although rest of the weed-management treatments were at par with each other. This could have been due to more weed competition in weedy check plots which forced the greengram crop to complete its life-cycle early due to deficiency of nutrients and moisture.

Total dry-matter accumulation (DMA) in plant (above-ground) revealed that it increased with the advancement of crop age (Table 2). Total dry-matter accumulation in plant remained unaffected due to planting methods at 15 DAS. However, at remaining stages of observation (30, 45 DAS and at maturity), among the planting methods, statistically higher DMA in plant was recorded in raised-bed method than the conventional and zero-till planting methods. This can be the result of better plant growth on bed planting owing to optimum growing condition in form of soil moisture, nutrient availability because of less competition by weeds which resulted in higher rate of photosynthesis and thus more DMA in plant.

Total dry matter accumulation in plant remained unaffected due to weed-management practices at 15 DAS. Except at 15 DAS, total DMA in plant was the maximum in weed-free treatment at all stages of observation (30, 45 DAS and at maturity) due to no competition offered by weeds which resulted in better growth of plant and hence photosynthesis, while the minimum was observed in weedy check treatment where huge weed competition resulted in poor growth of plant. Thus, accumulation of lower dry weight in weedy check treatment can be due to lack of internal nutrients in plant which caused reduction in both hypertrophy and hyperplasia and thus reduced synthesis of carbohydrate. Similar were the findings of Akter *et al*. (2013). At 30 DAS, weed-free treatment recorded the maximum DMA in plant (5.03 g/plant), followed by treatment having post-emergence application of imazethapyr @ 100 g/ha (4.44 g/plant). At 45 DAS, the maximum DMA in plant was recorded in weed-free treatment which was statistically at par with treatment having

HW (15 and 30 DAS). At maturity, among the treatments having herbicide application, post-emergence application of herbicide imazethapyr @ 100 g/ha resulted in significantly more total DMA in plant (31.8 g/plant) which was statistically at par with post-emergence application of imazethapyr @ 70 g/ha (31.3 g/plant) and post-emergence application of imazethapyr + imazamox @ 70 g/ha (30.5 g/plant).

Weed-control efficiency

Among different planting methods and weed-management treatments, raised-bed and HW (15 and 30 DAS), provided the highest weed-control efficiency (Table 3). Among the weed-management treatments having herbicides application, post-emergence application of imazethapyr @ 100 g/ha in each of planting methods resulted in the maximum weed-control efficiency (WCE),

Table 1. Effect of planting methods and weed management on phenological observations of greengram (mean data of 2 years)

Treatment	Days to emergence (75%)	Days to 50% flowering	Days to 50% pod formation	Days to physiological maturity
Planting method				
Raised bed	5.2	36.9	43.1	66.2
Conventional	5.3	36.8	43.1	66.0
Zero till	5.5	36.7	43.0	66.1
SEm±	0.10	0.10	0.07	0.08
CD (P=0.05)	NS	NS	NS	NS
Weed management				
Weed-free	5.4	36.9	43.3	66.3
Pendimethalin Pre (1,000 g/ha)	5.3	36.9	43.0	66.1
Imazethapyr Pre (70 g/ha)	5.4	36.7	43.1	66.5
Imazethapyr Pre (100 g/ha)	5.4	37.0	43.1	66.3
Imazethapyr 3–4-leaf stage (70 g/ha)	5.3	36.8	43.3	66.2
Imazethapyr 3–4-leaf stage (100 g/ha)	5.3	36.9	43.3	66.3
Imazethapyr + imazamox (RM) 3–4-leaf stage (70 g/ha)	5.4	37.0	43.3	66.3
Hand-weeding (15 and 30 DAS)	5.3	37.1	43.3	66.2
Weedy check	5.3	36.0	42.1	64.8
SEm±	0.12	0.18	0.15	0.17
CD (P=0.05)	NS	0.53	0.45	0.47

DAS, Days after sowing; Pre, pre-emergence, NS, non-significant

Table 2. Effect of planting methods and weed management on total dry-matter accumulation (g/plant) in plant (mean data of 2 years)

Treatment	15 DAS	30 DAS	45 DAS	At maturity
Planting method				
Raised bed	0.24	4.17	12.28	30.57
Conventional	0.24	3.86	10.32	27.28
Zero till	0.24	3.84	10.02	27.25
SEm±	0.001	0.01	0.07	0.16
CD (P=0.05)	NS	0.04	0.20	0.47
Weed management				
Weed-free	0.24	5.03	14.23	34.49
Pendimethalin Pre (1,000 g/ha)	0.24	3.59	9.56	24.49
Imazethapyr Pre (70 g/ha)	0.24	4.05	9.87	26.25
Imazethapyr Pre (100 g/ha)	0.24	4.15	10.04	26.95
Imazethapyr 3–4-leaf stage (70 g/ha)	0.24	4.32	11.62	31.35
Imazethapyr 3–4-leaf stage (100 g/ha)	0.24	4.44	11.93	31.80
Imazethapyr + imazamox (RM) 3–4-leaf stage (70 g/ha)	0.24	4.23	11.24	30.53
Hand-weeding (15 and 30 DAS)	0.24	3.32	12.68	32.37
Weedy check	0.24	2.50	6.66	17.07
SEm±	0.001	0.42	0.52	0.67
CD (P=0.05)	NS	1.26	1.56	2.00

DAS, Days after sowing; Pre, pre-emergence; NS, non-significant

followed by post-emergence application of imazethapyr @ 70 g/ha. Among the treatments having herbicide application, the maximum WCE was recorded in post-emergence application of imazethapyr @ 100 g/ha in raised-bed method (85.6%). The application of pendimethalin @ 1000 g/ha in each of planting method resulted in the minimum efficiency to control weeds.

Yield and economics

Raised-bed method of planting resulted in significantly maximum biological yield and seed yield as compared to conventional and zero-till planting methods (Table 4), as the growth parameters were improved in bed-planting method owing to better growing condition and lesser competition by weeds. Similar results were reported by Shivakumar *et al*. (2001), Dhindwal *et al*. (2006), Yadav and Singh (2014) in greengram and Kang *et al*. (2012) in soybean. Net returns and benefit: cost ratio were found higher in raised bed method followed by zero-till method.

Among different weed-management treatments, the maximum biological yield was observed in weed-free treatment. Weedy check treatment recorded the minimum biological yield due to higher competition of crop plants with the weeds. Pre-emergence application of imazethapyr @ 100 g/ha resulted in 42.4% higher biological yield than treatment receiving application of pendimethalin @ 1,000 g/ha, while post-emergence application of same herbicide @ 100 g/ha resulted in 61.5% higher yield than pendimethalin @ 1,000 g/ha. The maximum seed yield (1.11 t/ha) was found in weed-free treatment. Post-emergence application of imazethapyr @ 100 g/ha resulted in the maximum seed yield among the treatments having herbicide application. Similar results were reported by Singh *et al*. (2014) and Kumar *et al*. (2016) in greengram. Application of imazethapyr @ 100 g/ha as post-emergence resulted in 32.8% more seed yield than pre-emergence

Table 3. Weed-control efficiency (%) of different treatment combinations to control weeds before maturity (mean data of 2 years)

Weed management	Weed-free	Pendimethalin Pre (1,000 g/ha)	Imazethapyr Pre (70 g/ha)	Imazethapyr Pre (100 g/ha)	Imazethapyr 3–4–leaf stage (70 g/ha)	Imazethapyr 3–4–leaf stage (100 g/ha)	Imazethapyr + imazamox (RM) 3–4–leaf stage (70 g/ha)	Hand-weeding (15 and 30 DAS)	Weedy check
Planting method									
Raised bed	100	48.1	58.2	59.6	76.6	85.6	71.1	86.6	0
Conventional	100	46.2	53.2	56.0	71.9	79.3	66.5	83.1	0
Zero till	100	47.2	57.1	57.5	74.2	81.5	68.7	85.2	0

Pre, Pre-emergence; DAS, days after sowing

Table 4. Effect of planting methods and weed management on yield and economics of greengram (mean data of 2 years)

Treatment	Biological yield (t/ha)	Seed yield (t/ha)	Net returns (× 10^3₹/ha)	Benefit: cost ratio
Planting method				
Raised bed	3.28	0.85	17.6	1.73
Conventional	3.09	0.77	14.5	1.62
Zero till	3.08	0.76	15.8	1.72
SEm±	0.008	0.007		
CD (P=0.05)	0.023	0.020		
Weed management				
Weed-free	3.85	1.11	16.6	1.44
Pendimethalin Pre (1,000 g/ha)	2.26	0.47	3.5	1.17
Imazethapyr Pre (70 g/ha)	3.08	0.69	14.3	1.72
Imazethapyr Pre (100 g/ha)	3.22	0.73	15.8	1.78
Imazethapyr 3–4-leaf stage (70 g/ha)	3.53	0.93	25.6	2.28
Imazethapyr 3–4-leaf stage (100 g/ha)	3.65	0.97	27.2	2.33
Imazethapyr + imazamox (RM) 3–4-leaf stage (70 g/ha)	3.49	0.88	24.3	2.21
Hand-weeding (15 and 30 DAS)	3.83	1.05	20.4	1.65
Weedy check	1.41	0.28	-3.8	0.79
SEm±	0.024	0.009		
CD (P=0.05)	0.070	0.025		

Pre, Pre-emergence; DAS, days after sowing

application of same herbicide at same rate.

Maximum net returns and benefit: cost ratio were found in treatment having post-emergence application of imazethapyr @ 100 g/ha owing to less cost incurred in herbicide application than manual weeding in weed-free treatment. Similar were the findings of Singh *et al*. (2014) in green gram.

Based on 2 year study, raised-bed planting gave 10.5%, 10.8% higher seed yield and 22%, 11.3% higher net returns as compared to conventional and zero-till planting methods, respectively. Among different herbicidal treatments, imazethapyr @ 100 g/ha applied at 3–4-leaf stage was found most effective in controlling the weeds.

REFERENCES

Akter, R., Samad, M.A., Zaman, F. and Islam, M.S. 2013. Effect of weeding on the growth, yield and yield contributing characters of mungbean [*Vigna radiata* (L.) Wilczek]. *Journal of Bangladesh Agricultural University* **11**(1): 53–60.

Dhindwal, A.S., Hooda, I.S., Malik, R.K. and Kumar, S. 2006. Water productivity of furrow-irrigated rainy season pulses planted on raised beds. *Indian Journal of Agronomy* **51**(1): 49–53.

Kang, J.S., Singh, A. and Kaur, M. 2012. Studies on growth and yield of soybean [*Glycine max* (L.) Merrill] under different planting methods and fertility levels. *Legume Research* **35**(3): 265–267.

Kumar, N., Hazra, K.K. and Nadarajan, N. 2016. Efficacy of post emergence application of Imazethapyr in summer mungbean [*Vigna radiata* (L.) Wilczek]. *Legume Research* **39**(1): 96–100.

Malik, R.S., Yadav, A., Malik, R.K. and Singh, S. 2005. Performance of weed control treatments in mungbean under different sowing methods. *Indian Journal of Weed Science* **37**: 273–274.

Shivakumar, B.G., Mishra, B.N., Thippeswamy, H.M. and Balloli, S.S. 2001. Performance of rainy season green gram as influenced by land configuration and phosphorus. *Archives of Agronomy and Soil Science* **47**: 371–379.

Singh, G., Aggarwal, N. and Ram, Hari. 2014. Efficacy of post emergence herbicide imazethapyr for weed management in different mungbean (*Vigna radiata*) cultivars. *Indian Journal of Agricultural Sciences* **84**(4): 540–543.

Yadav, S. and Singh, B. 2014. Effect of irrigation schedules and planting methods on growth, productivity and WUE of greengram under Rice–wheat–greengram cropping system. *Plant Archives* **14**(1): 211–213.