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Performance of rainfed greengram (*Vigna radiata* L.) under various sowing dates and weed management practices

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ABSTRACT

The field experiment was conducted during 2015-16 in rabi season at Agricultural Research station, Kovilpatti, Tamil Nadu to study the response of different sowing dates and weed management practices on greengram growth, weed control and yield under rainfed situation. Research trial was conducted in split-plot design and replicated thrice. The treatments were pre monsoon (39th standard week), monsoon (41st standard week) and post monsoon sowing (43rd standard weeks) respectively in main plot with four different weed management practices with different chemicals viz., Pendimethalin, Quizalofop ethyl, Imazethapyr and hand weeding were tried in the sub plot. The results of the experiment revealed that sowing during pre monsoon (D_1) registered increased growth and yield parameters and grain yield (308 kg ha^{-1}). Among the weed management practices, application of pre-emergence application of (PE) Pendimethalin @ 0.75 kg a.i. ha^{-1} fb HW on 20 DAS (W_1) recorded significantly lower weed density and weed dry weight which in turn produced increased growth and yield attributes and yield of the crop (291 kg ha^{-1}) which was followed by pre-emergence application of Pendimethalin @ 0.75 kg a.i. ha^{-1} fb post-emergence (POE) application of Quizalofop ethyl @ 50 g a.i. ha^{-1} on 20 DAS (W_2)

Keywords: Greengram, growth, sowing dates, weed control and yield

Greengram is the third important pulse crop of India in terms of area and production. It is the cheapest source of dietary protein. Greengram is usually grown in low fertile soil under rainfed condition. Hence yield of crop is very low. The productivity gap analysis shows that there is wide gap between potential and average yield of green gram which means an ample possibility for getting higher yield of greengram by proper management practice. Evaluation of suitable management practices to increase the productivity of pulses even under rainfed situation is essential.

Greengram has its own definite abiotic and biotic requirement for its growth and development. Optimum sowing time helps plant to attain favourable environment. Vakeswaran *et al*. (2016) reported that late sowing of green gram during April 10th recorded lowest in all the yield attributing characters. Bobade *et al*. (2018) and Mule *et al.* (2020) reported that higher seed yield in early sowing (June 23rd , June 25th respectively) due to better crop growth, higher number of productive pods and seed weight plant^{-1} might be due to prevailing favourable climatic conditions in early sowing in monsoon season. Optimum time of sowing of greengram may vary from variety to variety and season to season due to variation in agro-ecological conditions. Therefore, there must be a specific sowing date to obtain maximum yield.

One of the major limitations in greengram cultivation is controlling of weeds. Yield reduction due to weeds leads to 30 to 80 % reduction in greengram during summer and *kharif* seasons while 70-80% during *rabi* season, respectively (Algotar *et al.,* 2015). Singh *et al.* (2015) concluded that pre-emergence (PE) application of pendimethalin @ 1000g a.i. ha^{-1} + 1 hand weeding minimizes total weed density throughout the crop growth period and produces maximum yield. Application of pendimethalin 30 EC+ imazethapyr 2 EC @ 1.00 kg a.i. ha^{-1} was found most effective in reducing population and dry mass of weeds and producing maximum yield of green gram at Nadia, West Bengal (Tamang *et al.,* 2015). Chaudhari *et al.* (2016) pointed out hand weeding and hand hoeing at 20 and 30 DAS leads to 3.4 %, 3.6 % yield increase in summer green gram over unweeded plot. The relative efficiency of different herbicides when applied alone or in combination with other herbicides and practices should be known to select best weed control methods.

Hence, present study was undertaken to study the relationship of yield with weather parameters and also the performance of different weed management practices on weed control in greengram.

MATERIALS AND METHODS

The field experiment was conducted during 2015-16 in *rabi* season (at Agricultural Research station, Kovilpatti, Tamil Nadu to study the response of different dates of sowing and weed management practices on greengram growth, weed control and yield under rainfed situation. Research trial was conducted in split-plot design and replicated thrice. The treatments were pre

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monsoon (39th standard week), monsoon (41st standard week) and post monsoon sowing (43rd standard weeks) respectively in main plot with four different weed management practices *viz.,* W_1- Pre-emergence (PE) Pendimethalin @ 0.75 kg a.i. ha^{-1} fb HW on 20 DAS, W_2- PE Pendimethalin @ 0.75 kg a.i. ha^{-1} fb Post-emergence (POE) Quizalofop- ethyl @ 50 g a.i. ha^{-1} on 20 DAS, W_3- PE Pendimethalin @ 0.75 kg a.i. ha^{-1} fb POE Imazethapyr @ 50 g a.i. ha^{-1} on 20 DAS, W_4- POE Imazethapyr @ 50 g a.i. ha^{-1} + Quizalofop- ethyl @ 50 g a.i. ha^{-1} (Tank mix) on 20 DAS in the sub plot. The soil was clay in texture with sub angular blocky in structure with WHC of 65%, EC: 0.32 dSm^{-1}, pH: 8.45, Available N: 140 kg ha^{-1}, Available P: 15.5 kg ha^{-1} and Available K: 340 kg ha^{-1}. Application of fertilizers @ 12.5: 25: 12.5: 10 kg NPKS ha^{-1} was done in all the years in the form of urea (N- 46%), Di-Ammonium Phosphate (DAP) (N- 18% and P- 46%) and Muriate of Potash (MOP) (K- 60%). The seeds were sown with the spacing of 30 × 10 cm. Crop was grown under pure rainfed condition without supplemental irrigation. Data on plant height, Leaf Area Index (LAI), Dry Matter Production (DMP), number of pods plant^{-1}, number of seeds pod^{-1}, 100 - seed weight and seed yield were recorded replication wise and were statistically analyzed. With regard to weeds, weed flora at 20 Days After Sowing (DAS), weed density and weed dry weight at different stages were observed. The meteorological data regarding rainfall, temperature, relative humidity and sunshine hours were collected from meteorological observatory located nearby cropped field at Agricultural Research Station, Kovilpatti. Derived parameters like Accumulated Growing Degree Day (AGDD) and Accumulated Helio Thermal Unit (AHTU) were worked out.

Weed flora, weed density and weed dry weight

The broad-leaved weeds like *Abutilon hirtum, Acalypha indica, Alysicarpus rugosus, Aristolochia bracteata, Bidens pilosa, Corchorus olitorius, Digera muricata, Eclipta prostrata, Hibiscus vitifolius, Phyllanthus maderaspatensis, Trianthema portulacastrum, Tridax procumbens, Vernonia cinerea,* sedge *Cyperus rotundus* and grassy weed like *Aristida funiculata, Rottboellia cochinchinensis* were observed in the experimental field. Sedges and broad-leaved weeds were higher in experimental field and grasses were less in number and dry matter production (Table 1 and 2).

Among the weed management practices, application of PE Pendimethalin @ 0.75 kg a.i. ha^{-1} fb HW on 20 DAS (W_1) recorded significantly lower weed density (8.3 nos m^{-2}) and weed dry weight (91.8 kg ha^{-1}) during 40 DAS (Table 2) which in turn produced increased growth and yield attributes and yield of the crop which was followed by PE Pendimethalin @ 0.75 kg a.i. ha^{-1} fb POE Quizalofop ethyl @ 50 g ha^{-1} on 20 DAS (W_2) and W_3- PE Pendimethalin @ 0.75 @ kg a.i. ha^{-1} fb POE Imazethapyr @ 50 g a.i. ha^{-1} on 20 DAS (W_3) (Table 2 and 3) This result was in line with the findings of Singh *et al*. (2015). There is no significant difference in weed density and weed dry matter production during 20 DAS in the treatment *viz.,* W_1, W_2 and W_3 as these three treatments received pendimethalin @ 0.75 kg a.i. ha^{1} as pre-emergence application (Table 1). Among the dates of sowing, there is no significant difference in total weed density at 20 DAS. Lower total weed density (12.7 nos. m^{-2}) and total weed dry matter production (DMP) (90.3 kg ha^{-1}) at 40 DAS was recorded by monsoon sown crop. Greengram sown during post monsoon (43rd standard week) recorded higher weed DMP at 20 (120.4 kg ha^{-1}) and 40 DAS (189.9 kg ha^{-1}). It might be optimum time of sowing provided better vigour to crop and encountered lesser weeds competition. Hariharasudhan *et.al.* (2017) reported that higher weed density and weed dry weight drastically increased in delayed sowing time from 1st August to 15th September. Monsoon sown crop produced significantly lower weed DMP at 40 DAS which may be due to stale seed bed method *i.e*., weeds grown during pre monsoon shower were destroyed by tillage before sowing of monsoon sown crop in order to give good growing environment.

Distributed rainfall and soil moisture

The distribution of rainfall and soil moisture was greatly influenced by sowing time. The crop received rainfall starting from 39th to 52nd standard week. During the cropping season, October month received rainfall of 139.1 mm in 8 rainy days, November month with 166.3 mm of rainfall in 9 rainy days and December month with 170.7 mm of rainfall in 10 rainy days. The crop growing (Northeast monsoon) season recorded 476.1 mm of rainfall as against the normal rainfall of 395.2 mm with an increase of 80.9 mm accounting for 20.5 % contribution to high soil moisture during the cropping period (Fig 1). Greengram is more sensitive to excess soil moisture and also crop received higher amount of rainfall during pod development stage and maturity is highly detrimental to yield of crop (Table 3). Hence yield of crop was severely affected and greengram recorded lowest yield than normal year yield.

Weather variables Vs time of sowing

Among the different sowing windows, the crop sown during the pre-monsoon period (39th standard week) received higher and even distribution of rainfall, and higher amount of temperature, AGDD and AHTU (Table 3 and Fig. 3) at all the stages of crop attributed to higher

Table 1 : Effect of sowing dates and weed management practices on weed density and weed dry matter production (DMP) on 20 days after sowing

Treatments	Weed density (No.m^{-2})				Weed DMP (kg ha^{-1})			
	Grasses	Sedges	BLW	Total	Grasses	Sedges	BLW	Total
Dates of sowing								
D_1	0.43 (0.75)	3.03 (9.83)	3.16 (10.00)	4.48 (20.58)	0.00 (0.00)	6.28 (39.50)	6.77 (48.33)	9.27 (87.83)
D_2	0.41 (0.68)	2.72 (7.67)	2.88 (8.67)	4.02 (17.01)	0.50 (1.00)	6.99 (50.16)	6.80 (46.83)	9.81 (97.99)
D_3	0.41 (0.67)	3.09 (9.67)	2.59 (7.00)	4.12 (17.33)	2.32 (10.83)	8.06 (66.65)	6.55 (43.00)	10.94 (120.48)
SEm (±)	**0.14**	**0.15**	**0.14**	**0.21**	**0.10**	**0.34**	**0.35**	**0.50**
LSD (0.05)	**0.39**	**NS**	**0.39**	**NS**	**0.28**	**0.95**	**NS**	**NS**
Weed management practices								
W_1	0.00 (0.00)	2.48 (6.44)	2.51 (6.55)	3.60 (13.00)	2.32 (9.56)	6.40 (41.10)	6.12 (37.56)	9.35 (88.21)
W_2	0.00 (0.00)	2.62 (6.89)	2.68 (7.22)	3.75 (14.11)	1.44 (6.22)	6.67 (44.89)	6.03 (36.67)	9.29 (87.78)
W_3	0.00 (0.00)	3.15 (10.44)	2.76 (7.78)	4.19 (18.22)	0.00 (0.00)	6.72 (45.67)	6.54 (42.78)	9.40 (88.45)
W_4	1.67 (2.79)	3.53 (12.44)	3.55 (12.67)	5.28 (27.90)	0.00 (0.00)	8.64 (76.76)	8.14 (67.22)	11.99 (143.98)
SEm (±)	**0.12**	**0.12**	**0.12**	**0.17**	**0.08**	**0.28**	**0.26**	**0.38**
LSD (0.05)	**0.25**	**0.25**	**0.25**	**0.36**	**0.16**	**0.59**	**0.55**	**0.81**
Interaction								
M at S SEm (±)	**0.23**	**0.24**	**0.23**	**0.33**	**0.15**	**0.54**	**0.52**	**0.76**
LSD (0.05)	**0.54**	**0.57**	**0.54**	**0.79**	**0.37**	**1.28**	**1.25**	**NS**
S at M SEm (±)	**0.20**	**0.21**	**0.20**	**0.30**	**0.14**	**0.48**	**0.45**	**0.67**
LSD (0.05)	**0.43**	**0.44**	**0.43**	**0.62**	**0.28**	**1.01**	**0.95**	**NS**

Note: Figures in the parentheses are original values

yield than other dates of sowing. The crop sown during the monsoon and post monsoon period (41st standard week and 43rd standard week) received higher amount of rainfall during the vegetative and pod development stage of the crop which affected the crop very severely which was reflected on the yield attributes and yield of green gram (Table 5). Correlation analysis showed that (Table 4), there is a negative correlation of rainfall during vegetative and pod development stage. Hence, increase in rainfall during these stages significantly affected the yield of greengram. This finding closely resembles to those reported by Miah *et al.* (2009) who opined that, the highest seed yield obtained from early sowing (2 March) might be due to suitable temperature prevailing accompanied by higher soil moisture content due to sufficient rainfall in April, which enhanced the vegetative as well as reproductive growth of the crop. Meanwhile lowest yield was recorded by late sown crop (April) due to excessive rainfall during pod filling stage in the month of June. Pre monsoon sown crop received higher sunshine hours day^{-1} during germination, vegetative and pod development stage (Fig. 2) which also influenced the yield positively. Post monsoon greengram received higher sunshine hours day^{-1} during 50% flowering stage has negative correlation with yield of crops. Higher evaporation (Fig. 2) during all the stages except at pod initiation stage has positive correlation with yield of crops. Pre monsoon sown crop recorded higher evaporation rate except at pod initiation stage than other dates of sowing which may also be the reason for higher yield under this treatment.

Effects of sowing dates and weed management practices on growth and yield attributes

Time of sowing significantly influenced the growth and yield attributes of greengram (Table 5). The results

Table 2 : Effect of sowing dates and weed management practices on weed density and weed dry matter production (DMP) on 40 days after sowing

Treatments	Weed density (No.m^{-2})				Weed DMP (kg ha^{-1})			
	Grasses	Sedges	BLW	Total	Grasses	Sedges	BLW	Total
Dates of sowing								
D_1	1.01 (1.08)	2.79 (9.33)	3.29 (11.08)	4.49 (21.50)	0.93 (2.00)	7.32 (54.33)	7.56 (60.00)	10.71 (116.33)
D_2	0.45 (0.83)	1.71 (4.00)	2.78 (7.92)	3.47 (12.74)	0.00 (0.00)	4.91 (33.33)	7.27 (57.00)	9.44 (90.33)
D_3	1.07 (2.42)	2.62 (8.00)	3.09 (9.83)	4.30 (20.25)	2.81 (21.83)	9.13 (85.17)	8.99 (82.91)	13.69 (189.91)
SEm (±)	0.04	0.14	0.16	0.22	0.09	0.36	0.38	0.55
LSD (0.05)	0.12	0.38	NS	0.61	0.24	1.00	1.06	1.52
Weed management practices								
W_1	0.27 (0.22)	1.54 (2.44)	2.38 (5.67)	2.88 (8.33)	0.86 (2.22)	6.93 (50.00)	6.28 (39.56)	9.51 (91.78)
W_2	0.33 (0.33)	1.67 (4.22)	2.89 (8.44)	3.53 (13.00)	0.00 (0.00)	9.14 (85.33)	7.04 (53.32)	11.56 (138.66)
W_3	0.82 (1.11)	2.46 (6.22)	3.24 (10.67)	4.21 (18.00)	1.10 (2.00)	7.25 (54.89)	8.61 (76.78)	11.33 (133.67)
W_4	1.96 (4.10)	3.83 (15.56)	3.69 (13.67)	5.73 (33.32)	3.03 (27.56)	5.17 (40.22)	9.82 (96.89)	12.72 (164.67)
SEm (±)	0.06	0.11	0.13	0.18	0.14	0.33	0.33	0.46
LSD (0.05)	0.12	0.24	0.27	0.37	0.29	0.68	0.69	0.97
Interaction								
M at S SEm (±)	0.10	0.22	0.25	0.34	0.22	0.61	0.62	0.88
LSD (0.05)	0.22	0.52	NS	0.82	0.49	1.42	1.47	2.09
S at M SEm (±)	0.10	0.20	0.22	0.31	0.24	0.56	0.57	0.80
LSD (0.05)	0.22	0.41	NS	0.64	0.50	1.18	1.19	1.69

Note: Figures in the parentheses are original values

Table 3 : Rainfall (mm) and maximum temperature received during different phenological stages of green gram

Phenological stages	Rainfall (mm)			Max T (^{o}C)		
	D1	D2	D3	D1	D2	D3
Germination	26.8	57.5	3.8	37.2	35.4	32.9
Vegetative	128.3	98.6	139.0	34.7	32.5	31.7
50% Flowering	63.6	50.6	58.1	32.7	30.3	31.0
50 % Pod Initiation	19.6	10.2	0.0	30.1	31.3	31.9
Pod Development	113.9	229.7	196.2	31.2	30.5	30.4
Physiological Maturity	56.8	14.4	7.3	30.6	30.4	30.5
Total/ Average	409.0	461.0	404.4	32.8	31.7	31.4

of the experiment revealed that sowing during pre monsoon registered significantly increased growth characters *viz*., plant height (65.7 cm) and DMP (4135 kg ha^{-1}), and yield parameters like number of pods plant^{-1} (27.2), number of seeds pod^{-1} (3.7), 100 - seed weight (2.4 g). Higher growth and yield attributes observed in the 39th standard week (pre monsoon) sown greengram might be due to early sowing enhanced the accumulation of more photosynthates due to optimum rainfall, AGDD and AHTU (Table 1) than later dates of sowing. Gurjar *et al*. (2018) also reported that, sowing of semi rabi green gram on 3rd week of September recorded significantly higher number of pods plant^{-1} (15.95) and pod length (8.03 cm), seeds pod^{-1} (11.46), highest 100 seed weight

Table 4 : Correlation coefficient value at different phenophases of green gram

Phenophase	Weather parameters/ Agrometeorological indices					
	Max. T	Min. T	SSH	RH	ET	RF
Germination stage	0.667*	-0.042	0.663*	-0.556	0.662*	0.408
Vegetative stage	0.617*	0.652*	0.589*	-0.538	0.557	-0.445
50% Flowering stage	0.291	0.257	-0.594*	-0.469	0.531	0.049
50% Pod initiation stage	-0.023	0.619*	-0.354	0.399	-0.191	-0.091
Pod Development stage	0.607*	0.602*	0.313	-0.617*	0.529	-0.130
Maturity stage	0.011	0.452	-0.191	0.370	-0.205	0.197

Table 5 : Effect of sowing dates and weed management practices on growth characters, yield parameters and yield of greengram

Treatments	Pl.ht. at harvest(cm)	DMP at harvest (kg ha^{-1})	LAI		No. of pods plant^{-1}	No. of seeds pod^{-1}	100 seed wt (g)	Yield (kg ha^{-1})
			Flow	PM				
Dates of sowing								
D_1	65.7	4135	7.1	3.9	27.2	3.7	2.4	308
D_2	63.9	3642	6.6	3.6	25.1	3.1	2.3	226
D_3	54.5	2987	5.7	2.8	19.1	2.2	1.8	168
SEm (±)	**2.9**	**171**	**0.3**	**0.2**	**1.1**	**0.1**	**0.1**	**11**
LSD (0.05)	**8.1**	**476**	**0.8**	**0.4**	**3.1**	**0.4**	**0.3**	**29**
Weed management practices								
W_1	65.8	3856	7.3	3.9	26.9	3.6	2.7	291
W_2	62.7	3760	6.8	3.5	24.9	3.2	2.4	262
W_3	60.0	3544	6.6	3.4	22.9	2.9	1.8	217
W_4	56.9	3191	5.2	2.8	20.3	2.3	1.6	167
SEm (±)	**2.4**	**147**	**0.3**	**0.1**	**1.0**	**0.1**	**0.1**	**11**
LSD (0.05)	**5.1**	**309**	**0.6**	**0.3**	**2.0**	**0.3**	**0.2**	**22**
Interaction								
M at S SEm (±)	**4.7**	**280**	**0.5**	**0.3**	**1.8**	**0.2**	**0.2**	**19**
LSD (0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
S at M SEm (±)	**4.2**	**255**	**0.5**	**0.2**	**1.7**	**0.2**	**0.2**	**18**
LSD (0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

Table 6 : Production economics of greengram as influenced by date of sowing and weed management practices

Treatments	Cost of cultivation (Rs. ha^{-1})	Gross returns (Rs. ha^{-1})	Net returns (Rs. ha^{-1})	B: C ratio
D_1W_1	17350	19983	2633	1.15
D_1W_2	17105	18792	1687	1.10
D_1W_3	17255	16042	-1213	0.93
D_1W_4	16755	13017	-3738	0.78
D_2W_1	17850	16042	-1808	0.90
D_2W_2	17605	14208	-3397	0.81
D_2W_3	17755	11000	-6755	0.62
D_2W_4	17255	8388	-8868	0.49
D_3W_1	17850	11963	-5888	0.67
D_3W_2	17605	10175	-7430	0.58
D_3W_3	17755	8800	-8955	0.50
D_3W_4	17255	6096	-11159	0.35

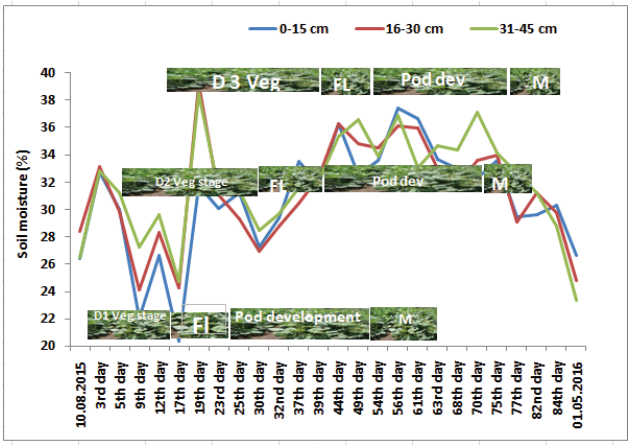

Fig. 1 : Soil moisture at different depths during cropping period of greengram

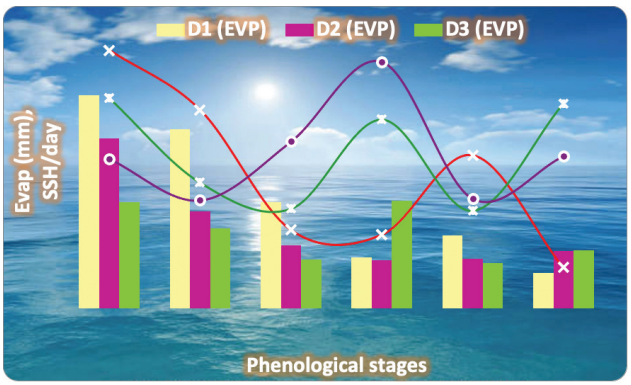

Fig. 2 : Sunshine hours day[1] & Evaporation (mm) experienced during different phenological stages of crop growth

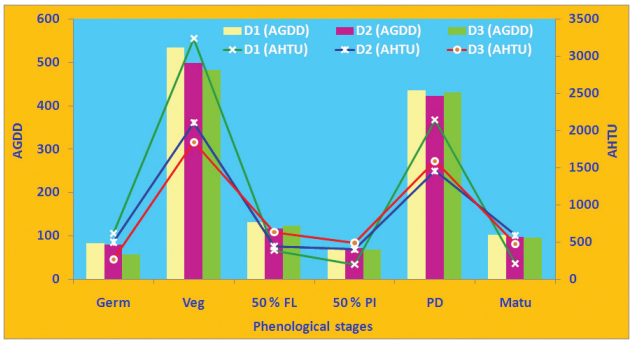

Fig. 3 : AGDD & AHTU experienced during different phenological stages of crop growth

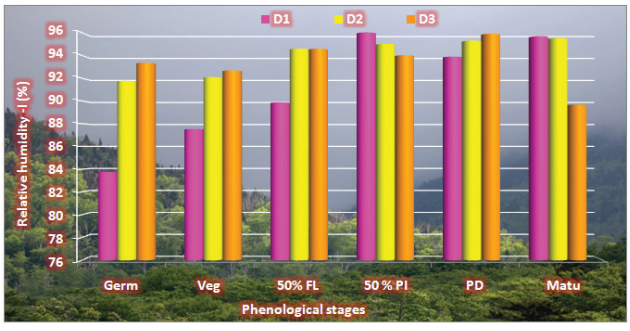

Fig. 4 Relative Humidity (%) experienced during different phenological stages of crop growth

(4.93 g) as compared to green gram sown during 1st and 3rd week of October.

Post monsoon sown greengram produced lowest plant height (54.5 cm), DMP (2987 kg ha^{-1}), number of pods plant^{-1} (19.1), number of seeds pod^{-1} (2.2), 100 seed weight (1.8 g). Findings of Jahan and Adam (2015) revealed that November 14 sown wheat produced maximum 1000-grain weight and there was a gradual decreasing trend with delayed sowing. Decrease in test weight is also due to shortening of grain filling duration in delayed sowing, which ultimately reduce grain weight (Poudel *et al.,* 2020).

Among the weed management practices, application of PE Pendimethalin @ 0.75 kg a.i. ha^{-1} fb HW on 20 DAS (W_1) recorded significantly lower weed density and weed dry weight which in turn produced increased growth characters *viz*., plant height (65.8 cm), DMP (3856 kg ha^{-1}) and yield parameters *viz*., number of pods plant^{-1} (26.9), number of seeds pod^{-1} (3.6), 100 seed weight (2.7 g). This is in line with the findings of Sudesh Kumar *et al*. (2019). This result was on par with application of PE Pendimethalin @ 0.75 kg a.i. ha^{-1} fb POE Quizalofop ethyl @ 50 g a.i. ha^{-1} on 20 DAS (W_2) (Table 5)

Seed yield

The results showed that significantly decreasing seed yield of greengram with the increasing of sowing period under different sowing dates. The maximum seed yield (308 kg ha^{-1}) was recorded under sowing of green gram during pre monsoon over sowing of green gram on monsoon and post monsoon period (226 and 168 kg ha^{-1}). Bobade *et al*. (2018) also reported that early sowing of green gram (June 23) recorded higher yield than late dates of sowing.

Among the weed management practices, PE application of Pendimethalin @ 0.75 kg a.i. ha^{-1} fb HW on 20 DAS (W_1) recorded significantly increased seed yield of green gram (291 kg ha^{-1}) due to their effectiveness in weed control in comparison to other weed management practices. Singh *et al*. (2015) concluded that Pendimethalin (pre-emergence) @ 1000 g a.i. ha^{-1} +1 hand weeding minimized total weed density throughout the crop growth period and produced maximum yield. And also, application of herbicides with hand weeding improved the tilth by making soil more vulnerable for the plants to utilize water and air.

Economics

The results showed that decreasing monetary return from *rabi* green gram with the increasing of sowing period under different sowing dates. The maximum net return (Rs. 2633/- ha^{-1}) and B:C ratio (1.15) were recorded under sowing of green gram during pre monsoon with application of PE Pendimethalin @ 0.75 a.i. kg ha^{-1} fb HW on 20 DAS over sowing of green gram during monsoon and post monsoon with other weed management practices.

Based on this experimentation, it may be concluded that, the sowing of green gram during pre monsoon with application of PE Pendimethalin @ 0.75 kg a.i. ha^{-1} fb Hand Weeding (HW) on 20 DAS were found beneficial for getting higher seed yield, net return and B:C ratio under rainfed vertisol condition. At the condition of human resource scarcity, pre-monsoon (39th standard week) sowing of greengram with application of PE Pendimethalin @ 0.75 kg a.i. ha^{-1} fb POE Quizalofop ethyl @ 50 g a.i. ha^{-1} on 20 days after sowing (W_2) were found to be suitable to get higher grain yield even in extreme wet and drought situation under vertisols condition.

AUTHOR'S CONTRIBUTION

Dr. S. Subbulakshmi designed the research plan, performed experimental works, collected the required data & analysed the data, prepared and finalized the manuscript. Final form of manuscript was approved by the author.

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