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Irrigation scheduling and weed management in *rabi* greengram (*Vigna radiata*)

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Abstract

An experiment was conducted in *rabi* season to study the weeds and yields of greengram as influenced by irrigation scheduling and weed management during 2018-19. Fifteen treatment combinations comprising three irrigation schedules *viz.*, irrigations at flowering, irrigations at flowering and pod development and irrigations at branching, flowering and pod development stage; five weed management practices *viz.*, Pendimethalin CS, Quizalofop-P-ethyl, Pendimethalin CS (PE) *fb* Quizalofop-P-ethyl (PoE), 2 HW at 20 and 40 DAS and unweeded check. were *Echinochloa* spp., *Trianthema portulacastrum*, *Digera arvensis*, *Physalis minima*, *Convolvulus arvensis* and *Cynodon dactylon*. were found as major weeds in experiment. The growth and yield attributes *viz.* plant height, number of branches/plant, dry matter accumulation, number of pods/plant, number of seeds/pod and 1000 seed weight were recorded significantly higher under Irrigations each at branching, flowering and pod development stage, ultimately produced higher seed and stover yield. Further, application of Pendimethalin CS 1 kg/ha significantly minimized the weed density and dry weight of weeds, resulted higher growth and yield of green gram crop. Whereas, weeds cause 58.8% yield losses under unweeded control. On the basis of interaction, it is inferred that irrigating the crop at branching, flowering and pod development and managed the weeds either through Pendimethalin CS 1.0 kg/ha (PE) or 2 HW at 20 and 40 DAS.

Keywords: Greengram, irrigations scheduling, pendimethalin cs, quizalofop-ethyl, weed management

Introduction

Greengram is locally known as “mung” or “mug” originated from India, considered as the most nutritious among pulses, free from heaviness and flatulence. It occupies prominent place that cover 3.38 million hectare area and contributes 1.61 million tonnes (DES, 2015) [4]. It is generally grown in rainy (*khari*) and summer seasons. Now-a-days, winter (*rabi*) cultivation of summer greengram is becoming popular in south Gujarat owing to favourable agro-climatic conditions and availability of short duration photo and thermo insensitiveness varieties. Moreover, the cultivation of greengram during the post-rainy season gives higher yield owing to favourable soil-moisture regime and availability of irrigation, less attack of insect-pests and diseases, and enhanced photosynthetic activity because of clear skies. Therefore, it is necessary to standardize management practices for cultivation of greengram in the post-rainy season. (Patel *et al.*, 2018) [15].

Amongst the various input management, water is the basic input for increasing crop production. Water stress at critical growth stage, limits the yield of greengram. Water stress reduces the rate of photosynthesis and uptake of nutrient in greengram (Phogat *et al.*, 1984) [19], affects crop phenology, leaf area development, flowering, pod setting and finally results in low yield (Salter & Goode, 1967) [24]. Therefore, rate and duration of crop growth need to be synchronized to water availability to get maximum seed yield (Monteith, 1986) [13]. Prasad *et al.*, (1989) [20] found higher yield of greengram with three irrigations; significant performance was also observed by Sukhivinder *et al.*, (1990) [28] when greengram crop was irrigated thrice. Limited irrigation water availability poses the question as to when and how much to irrigate to achieve the optimum water use efficiency. Thus, it is of paramount importance to determine the frequency as well growth stage at which the greengram can respond to irrigation more efficiently.

One of the main constraints for lower productivity of greengram crop in farmer's field is the "weed infestation". Weeds grow more vigorously in *rabi* and pose a serious threat to its cultivation. Being a short stature and relatively low crop growth, it faces heavy weed competition right from the early crop growth stages. Seed yield of greengram was maximum (2108 kg/ha) in the weed free treatment (Punia *et al.*, 2004)^[21], whereas about 69 per cent reduction in greengram grain yield due to weeds was estimated by Yadav and Singh (2005)^[32]. According to Pandey and Mishra (2003)^[14] weeds decreased the greengram productivity by 45.6 per cent; however, 56.7 per cent reported by Osari *et al.* (2019)^[25]. The losses of moongbean yield due to weeds was also reported at ranges from 65.4 to 79.0 per cent by Dunganwal *et al.* (2003)^[5] and 30 to 80 per cent by Algotar *et al.*, (2014)^[11]. Weed crop competition commences with germination of the crop and continues till its maturity. The predominant methods of weed control are hand weeding and inter-culturing in greengram, which are found effective reported by Hossain *et al.*, 1990^[7]; Kumar and Kiron, 1990^[10]. For avoiding drudgery and expenses on labour, chemical weed management practices should be tested for recommendation to the farmers as they are selective, cost effective, fairly easy to apply, have persistence that can be managed and offer flexibility in application time Patel *et al.* (2017)^[17]. Now a days, Pendimethalin 37.8% CS herbicide is gaining popularity, because it is easier to use, reduced staining, better tank mixability and active ingredient is preserved in the field even under extreme weather conditions, thus enabling longer protection for your crop from weed competition, hence, found more appropriate at lower rate compared to Pendimethalin 30 EC. Thus, the present study was contemplated with the objective to evaluate that up to what extent the effects of weed management and irrigation scheduling could be helpful in improving yield of a greengram.

Materials and Methods

A field experiment was conducted at College Farm, N. M. College of Agriculture, Navsari Agricultural University, Navsari (GJ), during *rabi* season of 2018-19 to study the "Irrigation scheduling and weed management in *rabi* green gram (*Vigna radiata* L.)". The soil of the experimental field was clayey in texture, low in available nitrogen (210 kg/ha), fairly rich in available phosphorus (41 kg/ha) and potash (384 kg/ha) with 7.9 pH. The experimental site was slightly alkaline in reaction with normal electrical conductivity (0.37). Total fifteen treatment combinations comprising three levels of irrigation scheduling *viz.*, Irrigations at flowering stage, Irrigations at flowering and pod development stage and Irrigations at branching, flowering and pod development stage; and five treatments of weed management *viz.*, Pendimethalin CS 1.0 kg/ha (PE), Quizalofop-P-ethyl 0.05 kg/ha at 20 DAS (PoE), Pendimethalin CS 1.0 kg/ha (PE) *fb* Quizalofop-P-ethyl 0.05 kg/ha at 40 DAS, Two HW at 20 and 40 DAS and Unweeded check. The experimental plots were 3.0 m wide and 4.0 m long, laid out according to factorial randomized block design with each treatment replicated three times.

The seed of greengram cultivar 'Co-4' treated with *rhizobium* culture (10 ml/lit. of water) was sown manually on third week of November using a seed rate of 20 kg/ha at a depth of 3 cm and maintaining 30 cm distance between crop rows. Required quantity of phosphorus (40 kg P₂O₅/ha) in form of single super phosphate and nitrogen (20 kg N/ha) in form of urea were weighed separately for each plot and band placed in

furrows at the depth of 6 to 8 cm just before sowing. After sowing, immediately a light irrigation was given to the crop for uniform germination and next day the herbicide was spray according to treatment. The requisite irrigation depth (50 mm) was maintained by parshall flume, having a throat width of 7.5 cm installed at the head of experiment plot. The time required, to irrigate the plot was calculated and the water was applied accordingly. Pendimethalin CS was applied as pre-emergence (PE) spray to the soil surface as per treatment on the next day of sowing and Quizalofop-P-ethyl was applied at 3-4 leaf stage as per treatment. Herbicides were applied using a knapsack sprayer fitted with flat-fan nozzle with spray volume of 460 l/ha. Hand weeding was done manually with the help of "khurpi" to keep the field free from weeds in weed free treatment and two hand weeding were done at 20 and 40 DAS in as per treatment. The package of recommended practices was adopted to maintain the crop.

A field vacated by sorghum crop was selected and previous field history reveals the presence of diversified weed flora of *rabi* season. Data on weed dynamics (density, dry biomass) was recorded at 20 and 40 DAS from two randomly selected quadrates (1 x 1 m) and at harvest from each experimental unit. Weeds were clipped from ground surface, dried in an oven at 65±5 °C for 48 h for determining dry weed biomass. The weed control efficiency and weed index were calculated by using formula according to Kundu *et al.* (2009)^[11].

Data on greengram yield attributes were recorded from five randomly selected plants taken from each net plot and computing their average. Length of pods in cm in sampled five plants were recorded from base of pod to the tip of the pod with the help of meter scale and then averaged out. A random sample of grain was taken from the produce of each plot, 1000 grains were counted manually, sundried to attend 15% moisture level and weighed in gram. Grain yield after threshing, cleaning and sun drying was taken and finally recorded in kg per hectare. After picking the pods, the remaining portion of the plant was harvested. The straw yield was calculated after the plant was completely dried. For obtaining the final straw yield, weight of straw of the observational plants were also added in the corresponding figures. The yield was then converted into kg per hectare. The data were subjected to Fisher's analysis of variance technique using "MSTATC" statistical software and p d" 0.05 probabilities was applied to compare the differences among treatments' means.

Results and Discussion

Weed flora

The major weed flora observed in the experimental field consisted of eight grass species, ten of broad-leaved weeds and one sedge. The grassy weeds were *Cynodon dactylon*, *Echinochloa colona*, *Echinochloa crus-galli*, *Sorghum helpense*, *Brachiaria ramosa*, *Eleusine indica* and *Digitaria sanguinalis*. *Cyperus rotundus* was only sedge and *Boerhavia diffusa*, *Euphorbia hirta*, *Alternanthera pungens*, *Trianthema portulacastrum*, *Vernonia cinerea*, *Convolvulus arvensis*, *Digera arvensis*, *Eclipta alba*, *Amaranthus viridis* and *Physalis minima* were the broad-leaved weeds. Similar findings were also reported by Chhodavadia *et al.* (2014), Chaudhari *et al.* (2016)^[2] in greengram. Further, grasses, broad-leaved weeds and sedges accounted about 42, 52 and 6 per cent of the total weeds in weedy plot at 40 days after sowing. The crop experienced severe weed competition during investigation, which might be due to favourable environmental conditions leading to vigorous growth of

weeds. All the weed management practices caused a significant reduction in weed density. Similar diversity of weeds and result was also reported during *rabi* season by Patel *et al.* (2012) [16] and Zinzala *et al.* (2016) [33] at Navsari.

Irrigation scheduling

Weed density

The data (Table 1) showed that total weed population was not altered at 20 DAS. However at 40 DAS, irrigation applied at branching, flowering and pod development stage recorded significantly the highest total weeds (68.6 plants/m²), while, irrigation at flowering stage recorded the lowest total weeds (55.8 plants/m²). This might be due to sufficient quantity of water favour more weed emergence and better growth of weed plants, which ultimately reflected in higher weed population and dry weight of weed. Similar results were also reported by Patel *et al.* (2011) [18] in blackgram for weed population and dry weight of weeds.

Dry weight

Similarly, dry weight of weeds at 40 DAS and harvest was also observed the highest when crop was irrigation at branching, flowering and pod development stage (38.3 g/m² and 646 kg/ha, respectively), while lowest recorded with one irrigation at flowering stage (31.5 g/m² and 535 kg/ha, respectively). The decrease in dry weight of weeds at lower rate of irrigation resulted from the least availability of moisture (Singh and Singh 2004) [21], which provides inadequate growing environment to weeds (Verma *et al.* 2008) [30].

Growth and yield

The growth attributes *viz.* plant height, number of branches/plant, dry matter accumulation, were recorded significantly higher when crop was irrigated thrice at branching, flowering and pod development stage). This might be due to fact that optimum moisture supply under more frequent irrigation ensures continually favorable soil moisture throughout the crop growth period, promoted the cell division and expansion of all the components, resulted in enhance plant stature with larger leaf area and commensurate carbohydrate synthesis leading to higher plant height, branches, dry matter accumulation compared to one and two irrigation frequency. The results are in confirmation to the finding of Trivedi *et al.* (1994) [29] and Idnani and Singh (2008) for greengram. The effect of irrigation schedule fails to exert its significant effects on days to 50 per cent flowering. Significantly higher yield attributing characters like pods/plant, seeds/pod and 1000 seed weight were found with three irrigation at branching, flowering and pod development stage. This might be due to better nourishment provided to the crop, leading to more accumulation of photosynthetic that better translocation of assimilates from sources to sink consequently bolder seed was obtain, finally reflected on seed setting and seed size. Similar findings were reported by Idnani and Singh (2008) [8] and Gami and Thanki (2011) [6] in greengram. Whereas, significantly lower growth and yield attributes were found under one irrigation at flowering stage subjected to water stress at vegetative growth stage which could be accumulate to decrease photosynthetic activity by partial closer of stomata and decreasing supply of CO₂ and moisture stress, deleterious effect on most of the physiological process of the crop and reduce synthesis of growth regulator such as cytokines and gibberellins (Kramer, 1969) [9] with one and two irrigation. Further, significantly

higher seed and stover yield was recorded with three irrigations, each applied at branching, flowering and pod development stage (1119 and 1860 kg/ha, respectively), that increased seed yield by 48.4 per cent and stover yield by 46.8 per cent compared to one irrigation at flowering stage.

Water use efficiency

Water use efficiency significantly decreased with increasing irrigation frequency and the highest water use efficiency (15.1 kg/ha-mm) was recorded under one irrigation applied at flowering stage.

Weed management

Weed density

The lowest weed density was observed in pre emergence herbicide treated plots with Pendimethalin CS 1.0 kg/ha alone or followed by application of Quizalofop-P-ethyl 0.05 kg/ha (PoE) at 40 DAS compared to 2 HW at 20 and 40 DAS, Quizalofop-P-ethyl 0.05 kg/ha (PoE), because the hand weeding and post emergence herbicide treatments was imposed after 20 DAS. It clearly indicated that pre emergence application of herbicides Pendimethalin significantly reduced the total weed population during initial period of crop growth, however, Quizalofop-P-ethyl effective against monocot only, hence, its effectiveness was not reflected in total weed population (Patel, *et al.* 2017) [17]. All sorts of weeds were significantly higher under unweeded check due to no management of weeds; they grew fully resulting in increased weed population.

Dry weight of weeds

At 40 DAS, the lowest dry weight of weeds was registered with Pendimethalin CS 1.0 kg/ha *fb* Quizalofop-P-ethyl 0.05 kg/ha (PoE) because application of Pendimethalin check the germination of weed seed and control the weed establishment of many annual broad leaf weeds and grasses, whereas, post emergence application of Quizalofop-P-ethyl control the later emerged grassy weeds resulted lower dry weight of weeds. At harvest the lowest dry weight of weeds was observed under two HW at 20 and 40 DAS, closely followed by Pendimethalin CS 1.0 kg/ha alone or combination with Quizalofop-P-ethyl 0.05 kg/ha (PoE). This might be due to killing of weeds by itself and herbicide compound would be very active during the initial period of application, however, during later stage hand weeding found to be superior method of weed management compare to herbicide application might be due to gradual decomposition of herbicide compound as the day proceeds. The results were supported by Raman and Krishnamoorthy (2005) [23] and Raj *et al.* (2012) [22] in greengram. Further, significantly the highest dry weight of weeds was recorded with treatment unweeded control at 40 DAS and at harvest because weeds were allowed to grow in plot throughout the crop growth period, ultimately increased the weeds population and dry weight of weeds.

Weed indices

Two hand weeding at 20 and 40 DAS (66.7%), registered maximum weed control efficiency, followed by Pendimethalin CS 1.0 kg/ha (PE) *fb* Quizalofop-p-ethyl 0.05kg/ha at 40 DAS (59.8%), Pendimethalin CS 1.0 kg/ha(55.5%). The weed control efficiency at harvest showed its trend due to different weed management treatments was in the order of W₄> W₃> W₁> W₂> W₅. Further application of Pendimethalin CS 1.0 kg/ha as PE was most effective by suppressing maximum weeds and also recorded maximum

greengram grain yield, hence used to compare the other treatment to calculate the weed index. Data show that 2 HW at 20 and 40 DAS recorded the lowest weed index (5.2%). The next to treatment was Pendimethalin CS 1.0 kg/ha (PE) *fb* Quizalofop-P-ethyl 0.050 kg/ha at 40 DAS (18.0%) and Quizalofop-P-ethyl 0.05 kg/ha at 20 DAS (37.5%). While, unweeded control recorded maximum weed index and suppressed the greengram crop yield up to 58.8 per cent.

Growth & yield

Two hand weeding at 20 and 40 DAS recorded significantly higher plant height (62.9 cm), number of branches /plant (7.87) found at par with Pendimethalin CS 1.0 kg/ha and Pendimethalin CS 1.0 kg/ha *fb* Quizalofop-P-ethyl 0.050 kg/ha at 40 DAS. Further, significantly higher dry matter accumulation at 60 DAS and yield attributes *viz.*, pods/plant, seeds/pod and 1000 seed weight was recorded under Pendimethalin CS 1.0 kg/ha, which was at par with Pendimethalin 1.0 kg/ha (PE) *fb* Quizalofop-P-ethyl 0.05 kg/ha and 2 HW at 20 and 40 DAS. Ultimately, result was reflected on greengram yield and significantly higher seed (1242 and 1178 kg/ha) and stover (2121 and 1997 kg/ha) yield was produced with application of Pendimethalin CS 1.0 kg/ha and twice hand weeding at 20 and 40 DAS, found equally effective and superior compared to rest of the weed management treatments. Significantly the lowest seed (512 kg/ha) and stover (826 kg/ha) yield was obtained in Unweeded Check.

The plant growth is the function of photosynthetic activity of the plant and their capacity to utilize available nutrients. It was due to favorable environment in the root zone resulting in absorption of more water and nutrients from soil and good control of weeds which ultimately resulted in less crop-weed competition throughout the growth of crop. Thus, enhance availability of nutrients, water, light and space which might have accelerated the photosynthetic rate, thereby increasing the supply of carbohydrates, which ultimately reflected in plant height and dry matter accumulation, consequently resulted into better development of reproductive structure and translocation of photosynthesis to the sink. The result corroborates with the Yadav *et al.* (2011) [31]. Yield obtained from 2 HW at 20 and 40 DAS was comparatively lower than Pendimethalin CS 1 kg/ha because disturbance of shallow root system by repeated hand weeding, being narrow spacing crop, manual hand weeding also damaged the leaves and plant parts, ultimately reduced the photosynthetic activity of plants. This finding is in conformity with those of Singh *et al.* (2018) [27]. Moreover, Pendimethalin 37.8% CS herbicide persist in soil much longer time as half life is greater than 90 days, even under extreme weather conditions, thus enabling longer protection for your crop from weed competition, that reflected in growth and yield of greengram.

Similarly, growth and yield of greengram was found inferior with Pendimethalin CS 1.0 kg/ha (PE) *fb* Quizalofop-P-ethyl 0.05 kg/ha (PoE) at 40 DAS, although the weed control

efficiency was higher (66.7%) because of suppression effect observed on growth and yield attributing parameters of green gram with application of Quizalofop-p-ethyl as it target the plants through the inhibition of fatty acid synthesis. Mahakavi (2014) [12] reported that quizalofop-p-ethyl treatment in balckgram decreased the photosynthetic pigments at a dose of $\geq 0.5\%$ quizalofop-p-ethyl solution at flowering stage (5 DAS) followed by pre-flowering (10 DAS) post-flowering stage (20 DAS) over their respective controls. Further, quizalofop-p-ethyl treatment decreased the *catalase* and *peroxidase* enzymes activities in a dose under ≥ 0.5 per cent quizalofop-p-ethyl solution at flowering stage. *Catalase* and *peroxidase* enzyme are considered as reactive oxygen species (ROS) scavenging enzymes in the plant system which split the hydrogen peroxide (H_2O_2) in to water and oxygen. Super oxide radicals (\bar{O}_2) and H_2O_2 anions are produced in plants under various abiotic and biotic stresses. These anions are toxic in nature, cause membrane damage and inactivation of various enzymes.

Water use efficiency

Significantly higher field water use efficiency noted under Pendimethalin CS 1.0 kg/ha, followed by two hand weeding at 20 and 40 DAS, whereas, the lowest under unweeded check. Effective weed control, achieved through the different weed management, reduced the crop weed competition with respect soil moisture, moisture depletion and space for optimum growth therefore more water available to crop ultimately produce higher grain yield which gave higher water use efficiency.

Interaction effect

Irrigation at branching, flowering and pod development stage and managed the weeds through application of Pendimethalin CS 1.0 kg/ha produced significantly higher seed (1462 kg/ha) and stover (2483 kg/ha) yield. Further, it was found at par with irrigation at branching, flowering and pod development stage + 2 HW at 20 and 40 DAS for seed yield (1448 and 1908 kg/ha, respectively). Moreover, the highest field water use efficiency of 19.6 kg/ha-mm was obtained with one Irrigation at flowering stage + Pendimethalin CS 1.0 kg/ha) and lowest field water use efficiency of 4.5 kg/ha-mm was observed in Irrigation at branching, flowering and pod development stage + unweeded check. Adequate moisture supply under effective weed control increased the availability of moisture and nutrients for crop considerably, which accelerated the physiological activities inside the plant subsequently more assimilation of photosynthetic resulted better performance ultimately increased the seed and stover yield. The lowest seed (344 kg/ha) and stover (668 kg/ha) was recorded with Irrigation at flowering stage in unweeded check treatment. However, negative relationship was noticed with increasing irrigation scheduling and unweeded check combination.

Table 1: Different weed parameters and incuses of *rabi* greengram as influenced by irrigation scheduling and weed management

Treatment	Total Weed counts/m ²				Dry weight of weeds		WI	WCE
	At 20 DAS		At 40 DAS		40 DAS (g/m ²)	At Harvest (kg/ha)	(%)	(%)
Irrigation at flowering stage	7.36	(56.0)	7.30	(55.8)	31.5	535	--	--
Irrigation at flowering and pod development stage	7.47	(58.1)	7.43	(57.8)	31.6	568	--	--
Irrigation at branching, flowering and pod development stage	7.56	(59.1)	8.15	(68.6)	38.3	646	--	--
SEm ±	0.12		0.14		1.00	16		
CD (P=0.05)	NS		0.39		2.9	46		
Weed management (W)								
Pendimethalin CS 1.0 kg/ha (PE)	5.37	(28.1)	6.88	(46.9)	22.9	455	0.0	55.5
Quizalofop-P-ethyl 0.05 kg/ha (PoE) at 20 DAS	8.79	(76.3)	7.97	(63.1)	30.0	689	37.5	32.5
Pendimethalin CS 1.0 kg/ha (PE) <i>fb</i> Quizalofop-P-ethyl 0.05 kg/ha (PoE) at 40 DAS	5.41	(28.3)	5.88	(34.0)	20.6	411	18.0	59.8
Hand weeding at 20 and 40 DAS	8.82	(77.0)	6.47	(41.0)	21.6	340	5.2	66.7
Unweeded check	8.93	(78.9)	10.93	(118.7)	74.1	1022	58.8	0.0
SEm ±	0.15		0.17		1.3	20		
CD (P=0.05)	0.45		0.51		3.7	59		
CV%	6.2		6.9		11.2	10.5		
Interaction (I x W)	NS		NS		SIG	SIG		

*Data in parenthesis indicate original value of weeds and outside the bracket the transformed value of $\sqrt{X+1}$.

Table 2: Growth and yield attributes of *rabi* greengram as influenced by irrigation scheduling and weed management

Treatment	Plant height at harvest (cm)	branches/ plant at 60 DAS (No.)	50% flowering (Days)	DMA at 60 DAS (g/plant)	Pods/ plant (No.)	Seeds/ pod (No.)	1000 seed weight (g)
Irrigation scheduling (I)							
Irrigation at flowering stage	55.2	7.09	52.5	12.25	18.3	7.17	43.5
Irrigation at flowering and pod development stage	58.2	7.13	52.6	13.38	19.4	7.16	44.4
Irrigation at branching, flowering and pod development stage	63.5	8.00	53.7	16.28	20.4	7.85	46.6
SEm ±	1.3	0.18	0.8	0.31	0.5	0.19	0.7
CD (P=0.05)	3.8	0.53	NS	0.91	1.3	0.54	2.2
Weed management (W)							
Pendimethalin CS 1.0 kg/ha (PE)	60.5	7.82	52.8	15.16	20.4	8.09	46.9
Quizalofop-P-ethyl 0.05 kg/ha (PoE) at 20 DAS	57.9	7.13	52.7	13.16	18.9	7.07	43.8
Pendimethalin CS 1.0 kg/ha (PE) <i>fb</i> Quizalofop-P-ethyl 0.05 kg/ha (PoE) at 40 DAS	60.2	7.51	53.0	14.58	19.8	7.62	44.8
Hand weeding at 20 and 40 DAS	62.9	7.87	52.9	14.84	20.4	7.93	45.9
Unweeded check	53.5	6.71	53.2	12.12	17.4	6.27	43.2
SEm ±	1.7	0.24	1.1	0.41	0.6	0.24	1.0
CD (P=0.05)	4.9	0.69	NS	1.17	1.7	0.70	2.8
CV%	8.6	9.60	6.0	8.71	9.1	9.8	6.4

Table 3: Seed & stover yield and field water use efficiency (FWUE) of *rabi* greengram as influenced by irrigation scheduling and weed management

Weed Management	Seed yield (kg/ha)				Stover yields (kg/ha)				FWUE (kg/ha-cm)			
	Irrigation scheduling											
	I ₁	I ₂	I ₃	Mean	I ₁	I ₂	I ₃	Mean	I ₁	I ₂	I ₃	Mean
W ₁	981	1283	1462	1242	1656	2223	2483	2121	19.6	12.8	9.7	14.1
W ₂	630	826	873	776	1078	1384	1417	1293	12.6	8.3	5.8	8.9
W ₃	797	1127	1132	1019	1313	1896	1918	1709	15.9	11.3	7.5	11.6
W ₄	966	1119	1448	1178	1629	1908	2455	1997	19.3	11.2	9.7	13.4
W ₅	394	459	682	512	668	787	1024	826	7.9	4.6	4.5	5.7
Mean	754	963	1119		1269	1640	1860		15.1	9.6	7.5	
	I	W	I x W		I	W	I x W		I	W	I x W	
SEm ±	24	31	54		42	54	93		0.3	0.4	0.7	
CD (P=0.05)	70	90	156		120	155	269		0.8	1.1	1.9	
CV%	9.9				10.1				10.5			

Note : Three treatments of irrigation scheduling viz., Irrigations at flowering stage (I₁), Irrigations each at flowering and pod development stage (I₂) and Irrigations each at branching, flowering and pod development stage (I₃) and five treatments of weed management practices viz., Pendimethalin CS 1.0 kg/ha (PE) (W₁), Quizalofop-P-ethyl 0.05 kg/ha at 20 DAS (W₂), Pendimethalin CS 1.0 kg/ha (PE) *fb* Quizalofop-P-ethyl 0.05 kg/ha at 40 DAS (W₃), two hand weeding 20 and 40 DAS (W₄) and unweeded check (W₅)

Conclusion

In the view of result obtain from present investigation it could be ascertained that irrigation applied at branching, flowering

and pod development stage produce higher seed yield of *rabi* greengram. Further, Pendimithalin CS 1 kg/ha or 2 HW at 20 and 40 DAS found equally effective by producing maximum

greengram yield by managing the weeds efficiently, however, unweeded control cause yield losses up to 58.8 per cent. Thus, it can be concluded that pre emergence application of Pendimethalin CS 1 kg/ha and irrigate the field at branching, flowering and pod development stage with one common irrigation for germination at sowing found beneficial for securing higher yield of greengram.

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