Indian Journal of Weed Science (2022) **54**(3): 318–320
http://dx.doi.org/10.5958/0974-8164.2022.00057.0

RESEARCH NOTE

Effect of herbicides on complex weed flora and yield of summer greengram

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Received: 18 January 2022 | Revised: 7 July 2022 | Accepted: 9 July 2022

ABSTRACT

To study the effect of a few herbicides on weed dynamics and yield of summer greengram (*Vigna radiata* L.), a field experiment was conducted on loamy sand soil during summer season of 2020. *Digitaria sanguinalis, Cynodon dactylon, Eleusine indica* and *Dactyloctenium aegyptium* among monocot and *Digera arvensis, Portulaca oleracea, Trianthema monogyna* and *Phyllanthus niruri*, the dicot weeds were dominant in experimental field. The pre-emergence application (PE) of either pendimethalin 750 g/ha or pendimethalin + imazethapyr (pre-mix) 750 g/ha or oxyfluorfen 117.5 g/ha PE or inter-cultivation twice and hand weeding twice at 20 and 40 days after seeding (DAS) significantly reduced the density and biomass of monocot and dicot weeds in summer greengram. These treatments recorded higher greengram growth, yield attributes, *viz.* plant height plant dry biomass, nodule dry weight, number of pods/plant, seed yield and benefit cost ratio (B:C).

Keywords: Greengram, Herbicide, Oxyfluorfen, Pendimethalin + imazethapyr, Weed management

Greengram [*Vigna radiata* (L.) R. Wilczek] is a leguminous crop considered to be the hardiest of all pulse crops and has the capacity to fix atmospheric nitrogen through symbiotic nitrogen fixation. The infestation of annual and perennial weeds in summer greengram, especially at early stages of crop growth, pose considerable competition for nutrient, water, light and space with crop plants and causing hindrance in achieving desired yield. The potential yield loss in greengram due to weeds has been estimated to range between 10-45% (Rao and Chauhan 2015). Thus, weed management is the key factor for enhancing the productivity of greengram. Moreover, besides low yield of crop, weeds increase production cost, harbor insect-pest and diseases, decreasing quality of farm produce. Currently, herbicide usage for weed management is becoming popular among the farmers due to unavailability of labour in time and also due to higher labour wages. Hence, the effect of a few herbicides on weeds and greengram was studies in this experiment to identify suitable herbicides for managing weeds in summer greengram.

This field study was carried out on loamy sand soil during summer season of 2020 at Agronomy farm of B. A. College of Agriculture, Anand Agricultural University, Anand, Gujarat. The total rainfall receiving during the crop period was 78.2 mm. The mean weekly maximum temperature ranged between 34.7 °C to 42.5 °C and minimum temperature ranged from 20.1 °C to 28.0 °C during the crop season. The soil of experimental field was low in organic carbon (0.34%), medium in available phosphorus (38.21 kg/ha), high in available potash (282.7 kg/ha) and slightly alkaline in reaction (pH 7.97). Ten treatments were tested including: pre-emergence application (PE) of pendimethalin 750 g/ha, oxyfluorfen 117.5 g/ha and pendimethalin + imazethapyr (pre-mix) 750 g/ha, post-emergence application (PoE) of imazethapyr 70 g/ha, imazethapyr + imazamox (pre-mix) 70 g/ha, fluazifop-p-butyl + fomesafen (pre-mix) 250 g/ha, propaquizafop + imazethapyr (pre-mix) 125 g/ha, sodium acifluorfen + clodinafop-propargyl (pre-mix) 245 g/ha and inter-cultivation (IC) followed by (*fb*) hand weeding (HW) at 20 and 40 days after seeding (DAS) and weedy check. A randomized block design with four replications was used. Pre- and post-emergence herbicides were applied one day and 28 days after sowing, respectively with knapsack sprayer fitted with flat fan nozzle by using 500 litre of water/ha as per treatment. Sowing of the greengram variety 'GAM 5' was done on 20th March 2020 using a seed rate of 20 kg/ha keeping the row spacing of 30 cm. Recommended dose of fertilizer (NPK 20-40-00 kg/ha) was applied common to all the treatments as a basal dose in the form of urea and single super phosphate. Seven irrigations were given to the crop. Weed samples were collected by arbitrarily placing a quadrat of size 0.25 m^2 in each plot at 25, 60 DAS and at harvest and the data was converted into m^2. For

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uniformity, data related to weed parameters were subjected to square root transformation ($\sqrt{x+1}$). Other growth and yield attributing observation, *viz.* plant height at 30, 60 DAS and at harvest, nodule dry weight (mg/plant) at 39 DAS, plant dry matter (g/plant) at 39 DAS, seed and haulm yield were recorded from net plot area using standard procedures.

Weed flora

Digitaria sanguinalis, Cynodon dactylon, Eleusine indica and *Dactyloctenium aegyptium* as monocot and *Digera arvensis, Portulaca oleracea, Trianthema monogyna* and *Phyllanthus niruri* as dicot were the dominant weeds observed in the experimental field of summer greengram.

Effect on weeds

Complete control of monocot and dicot weeds was recorded with IC *fb* HW at 20 and 40 DAS (**Table 1**). Complete control of monocot weeds at 25 DAS was achieved with pendimethalin 750 g/ha PE and pendimethalin + imazethapyr (pre-mix) 750 g/ha PE. At 50 DAS, pendimethalin 750 g/ha PE, pendimethalin + imazethapyr (pre-mix) 750 g/ha PE and oxyfluorfen 117.5 g/ha PE remained at par with each other and recorded significantly lower biomass of monocot and dicot weeds except dicot weeds with oxyfluorfen 117.5 g/ha. At harvest, significantly lowest density of total weeds was achieved under IC *fb* HW and was at par with pendimethalin 750 g/ha PE with respect to total weeds biomass due to broad spectrum control of weeds with pendimethalin + imazethapyr PE and pendimethalin PE. Further, IC *fb* HW was found more effective in managing the monocot and dicot weeds as initially emerged weeds were controlled by inter-culturing and hand weeding carried out at 20 DAS and weeds emerged later were efficiently managed by additional inter-culturing and hand weeding carried out at 40 DAS. Effective management of weeds through cultural practices was also reported by Panda *et al.* (2021).

Effect on crop

The weed management practices did not exert any significant influence on plant population recorded at 20 DAS whereas, plant height was significantly influenced at 30, 60 DAS and at harvest (**Table 2**). The higher plant height was recorded at 30 DAS under weedy check treatment while at 60 DAS and at harvest higher plant height was observed under pendimethalin 750 g/ha PE. The results are in agreement findings of Patel *et al.* (2016). IC *fb* HW at 20 and 40 DAS registered significantly higher plant dry biomass and nodule dry weight and it was at par with pendimethalin 750 g/ha PE, pendimethalin + imazethapyr (pre-mix) 750 g/ha PE, oxyfluorfen 117.5 g/ha PE, propaquizafop + imazethapyr (pre-mix) 125 g/ha PoE and sodium acifluorfen + clodinafop-propargyl (pre-mix) 245 g/ha PoE with

Table 1. Effect of treatments on density and biomass of monocot and dicot weeds in summer greengram

Treatment	Density (no./ m^2)						Biomass (g/m^2)					
	Monocot			Dicot			Monocot			Dicot		
	25 DAS	50 DAS	At harvest	25 DAS	50 DAS	At harvest	25 DAS	50 DAS	At harvest	25 DAS	50 DAS	At harvest
Pendimethalin 750 g/ha PE	1.00^{b} (0)	2.77^{e} (7)	4.33^{de} (18)	1.62^{cd} (2)	2.43^{e} (5)	2.77^{e} (7)	1.00^{b} (0.00)	3.27^{e} (10.01)	7.07^{f} (49.11)	1.95^{g} (3.72)	2.87^{e} (7.40)	3.98^{d} (15.63)
Oxyfluorfen 117.5 g/ha PE	1.31^{b} (1)	4.15^{d} (17)	4.77^{cde} (22)	2.81^{b} (7)	2.62^{de} (6)	3.15^{de} (9)	1.22^{b} (0.62)	4.74^{d} (21.81)	8.77^{e} (75.9)	3.17^{f} (9.17)	3.33^{e} (10.17)	6.87^{bc} (46.15)
Pendimethalin + imazethapyr EC (pre-mix) 750 g/ha PE	1.00^{b} (0)	2.62^{e} (6)	4.56^{cde} (20)	2.12^{bc} (4)	2.62^{de} (6)	3.30^{cde} (10)	1.00^{b} (0.00)	3.33^{e} (10.26)	7.35^{ef} (53.19)	2.56^{fg} (6.54)	3.09^{e} (8.76)	5.77^{c} (32.30)
Imazethapyr 70 g/ha PoE	9.46^{a} (89)	6.23^{b} (38)	5.08^{bcd} (25)	4.97^{a} (24)	3.86^{b} (14)	4.22^{b} (17)	8.31^{a} (68.46)	7.73^{b} (58.99)	14.24^{ab} (203.85)	6.52^{cd} (42.15)	5.29^{cd} (27.19)	8.47^{b} (71.18)
Imazethapyr + imazamox (pre-mix) 70 g/ha PoE	8.98^{a} (80)	5.09^{cd} (25)	5.38^{abc} (28)	4.64^{a} (21)	3.30^{bc} (10)	3.86^{bcd} (14)	7.64^{a} (57.49)	6.45^{c} (40.73)	11.92^{cd} (143.34)	5.80^{de} (33.17)	6.95^{b} (47.93)	7.27^{bc} (52.93)
Fluazifop-p-butyl + fomesafen (pre-mix) 250 g/ha PoE	8.90^{a} (79)	5.90^{bc} (36)	5.99^{ab} (35)	5.19^{a} (26)	3.58^{bc} (12)	3.98^{bc} (15)	7.52^{a} (55.90)	7.20^{bc} (51.51)	13.79^{b} (191.01)	7.24^{bc} (51.35)	5.07^{d} (25.20)	7.01^{bc} (48.57)
Propaquizafop + imazethapyr (pre-mix) 125 g/ha PoE	9.20^{a} (84)	5.29^{bc} (27)	4.79^{cde} (22)	4.77^{a} (22)	3.11^{cd} (9)	3.61^{bcd} (12)	7.57^{a} (56.45)	6.28^{c} (38.62)	11.03^{d} (121.10)	5.45^{e} (28.88)	5.76^{cd} (32.34)	7.07^{bc} (50.42)
Sodium-acifluorfen + clodinafop-propargyl (pre-mix) 245 g/ha PoE	9.04^{a} (81)	5.28^{bc} (27)	4.98^{cd} (24)	5.18^{a} (26)	3.43^{bc} (11)	4.35^{b} (18)	7.62^{a} (57.09)	6.52^{c} (41.83)	13.31^{bc} (176.29)	7.83^{b} (61.00)	6.25^{bc} (38.87)	8.54^{b} (72.92)
IC *fb* HW at 20 and 40 DAS	1.00^{b} (0)	1.00^{f} (0)	3.86^{e} (14)	1.00^{d} (0)	1.00^{f} (0)	1.62^{f} (2)	1.00^{b} (0)	1.00^{f} (0.00)	6.25^{f} (38.12)	1.00^{h} (0)	1.00^{f} (0.00)	3.40^{d} (16.35)
Weedy check	9.42^{a} (88)	10.19^{a} (104)	6.37^{a} (41)	5.19^{a} (26)	6.21^{a} (38)	6.69^{a} (44)	7.84^{a} (60.95)	14.03^{a} (196.25)	15.51^{a} (239.69)	9.30^{a} (85.50)	11.67^{a} (135.34)	14.86^{a} (219.81)
LSD (p=0.05)	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.

Figure in parentheses are original values and subjected to square root transformation ($\sqrt{x+1}$) before statistical analysis. PE: Pre-emergence; PoE: Post-emergence; DAS: Days after seeding; *fb*: Followed by; IC: Inter-culturing; HW: Hand weeding

Table 2. Effect of treatments on growth, yield attributes and yield of summer greengram

Treatment	Plant population (per meter row length) at 20 DAS	Plant height (cm)			Plant dry biomass (g/plant) at 39 DAS	Nodule dry weight (mg/plant) at 39 DAS	No. of pods/ plant	Seed index (g) (100 seed wt.)	Seed yield (kg/ha)	B:C
		30 DAS	60 DAS	At harvest						
Pendimethalin 750 g/ha PE	10.23	15.45^{ab}	43.78^{a}	47.28^{a}	31.06^{ab}	40.37^{a}	30.05^{a}	4.61	1401^{a}	3.29
Oxyfluorfen 117.5 g/ha PE	10.18	15.03^{abc}	42.20^{a}	45.25^{ab}	29.61^{abc}	38.32^{a}	29.60^{a}	4.60	1337^{a}	3.40
Pendimethalin + imazethapyr (pre-mix) 750 g/ha PE	10.20	15.08^{abc}	43.68^{a}	45.93^{ab}	30.57^{abc}	38.82^{a}	29.95^{a}	4.61	1377^{a}	3.30
Imazethapyr 70 g/ha PoE	10.08	14.78^{abc}	40.23^{ab}	42.28^{bc}	27.13^{c}	36.38^{ab}	15.85^{c}	4.41	769^{c}	1.91
Imazethapyr + imazamox (pre-mix) 70 g/ha PoE	10.10	12.75^{c}	40.53^{ab}	43.50^{ab}	27.25^{bc}	36.89^{ab}	20.63^{b}	4.54	1043^{b}	2.50
Fluazifop-p-butyl + fomesafen (pre-mix) 250 g/ha PoE	10.10	14.58^{abc}	40.25^{ab}	43.43^{ab}	27.04^{c}	36.57^{ab}	16.75^{c}	4.54	882^{bc}	2.11
Propaquizafop + imazethapyr (pre-mix) 125 g/ha PoE	10.18	14.03^{abc}	40.58^{ab}	44.03^{ab}	29.52^{abc}	38.35^{a}	29.35^{a}	4.59	1291^{a}	3.13
Sodium acifluorfen + clodinafop-propargyl (pre-mix) 245 g/ha PoE	10.08	13.05^{bc}	40.55^{ab}	43.73^{ab}	29.01^{abc}	36.78^{ab}	20.35^{b}	4.57	1003^{b}	2.39
IC *fb* HW at 20 and 40 DAS	10.30	14.80^{abc}	41.15^{a}	44.98^{ab}	32.75^{a}	40.58^{a}	30.75^{a}	4.63	1408^{a}	2.88
Weedy check	10.05	16.38^{a}	36.70^{b}	38.55^{c}	27.11^{c}	33.60^{b}	8.95^{d}	4.51	344^{d}	0.92
LSD (p=0.05)	NS	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	NS	Sig.	-

PE: Pre-emergence; PoE: Post-emergence; DAS: Days after seeding; *fb:* Followed by; IC: Inter-culturing; HW: Hand weeding

respect to plant dry biomass. While in case of nodule dry weight all the weed control treatments remained at par with each other except weedy check. All the yield attributing and yields *viz.*, number of pods/plant and seed yield were significantly higher under IC *fb* HW at 20 and 40 DAS which remained at par with pendimethalin 750 g/ha PE, pendimethalin + imazethapyr (pre-mix) 750 g/ha PE, oxyfluorfen 117.5 g/ha PE and propaquizafop + imazethapyr (pre-mix) 125 g/ha PoE). The results are in accordance with the findings of Subbulakshmi (2021) and Ramesh and Rathika (2020). The higher seed yield was due to effective control of weeds which reduced the crop weed competition at the critical growth stages of greengram and provided almost weed free environment that facilitated better growth, development and increase in yield. Similarly, effectiveness of imazethapyr + pendimethalin 800 g/ha on increasing seed yield was also observed by Singh *et al.* (2017) and Kumar *et al.* (2019) while in case of cultural practices Patel *et al.* (2016).

Economics

The economic analysis revealed maximum benefit cost ratio achieved with oxyfluorfen 117.5 g/ha PE (3.40) which was closely followed by pendimethalin + imazethapyr (pre-mix) 750 g/ha PE (3.30) and pendimethalin 750 g/ha (3.29) PE. Gupta *et al.* (2019) also recorded higher B:C with pendimethalin + imazethapyr (RM) 750 g/ha PE in greengram.

Based on the results it was concluded that effective and economical weed management in summer greengram can be achieved by application of either pendimethalin 750 g/ha PE or pendimethalin + imazethapyr (pre-mix) 750 g/ha PE or oxyfluorfen 117.5 g/ha PE or inter-cultivation and hand weeding at 20 and 40 days after seeding (DAS).

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