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Effect of mulching and herbicides on weed dynamics and productivity of black gram

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Abstract
Background: Blackgram (*Vigna mungo*) a self-pollinated leguminous crop grown throughout India in both the summer and rainy seasons and contains 24% protein and enriches the soil by fixing up to 70-90 kg of atmospheric nitrogen per hectare. Unchecked weeds have been shown to significantly reduce seed yield, hand weeding is dangerous and unfeasible due to the season-long rain. Chemical weed control emerged as a practical and economical solution for controlling weeds in the production of black grams. Mulching was successful in keeping in-situ moisture and suppressing weeds. Mulching lowers weed growth, slows down soil deterioration, and controls water evaporation, and enhances the physical, chemical, and biological qualities of the soil. The objective of the study was to study the effect of mulching and herbicides on weed dynamics and productivity of Black gram.
Methods: At the Research Farm of KVK Reasi, a field experiment was carried out during the kharif seasons of 2021 and 2022 to examine the effects of mulching and pesticides on weed dynamics, crop growth, yield quality, and yield of black gram (mash).
Result: Ten treatment viz. were included in the RBD design of the trial. T_1: One kilogram of pendimethalin a.i./ha T_2: 0.0575 kg a.i./ha of imimazethapyr, T_3: Ethyl quizalofop at 0.050 kg a.i./ha, T_4: Imazethapyr @ 0.075 kg a.i /ha fb Pendimethalin @ 1 kg a.i /ha, T_5: fb Quizalofop-ethyl @ 0.050 kg a.i /ha & pendimethalin @ 1 kg a.i /ha T_6: Grasping, T_7: 1 kilogram of pendimethalin a.i./ha fb Three replications of T_8 (hand weeding at 20 and 40 DAS), T_9 (weed free), and T_{10} (weedy check) were conducted. In terms of weed control efficiency (WCE), two hand weedings at 20 and 40 DAS were found to be highly effective. They also produced the highest crop growth, yield attributes, and seed yield (905 kg/ha), which is comparable to the weed control efficiency (WCE) of pendimethalin @ 1 kg a.i /ha fb Mulching, pendimethalin @ 1 kg a.i /ha fb Imazethapyr @ 0.075 kg a.i /ha, and pendimethalin @ 1 kg a.i /ha fb Quizalofop-ethyl @ 0.050 kg a.i /ha.

Keywords: Black gram, mulching, herbicide, weed dynamics

Introduction
One of the major pulses that is grown all over India in both the summer and the rainy season is blackgram (*Vigna mungo*). The seeds of this leguminous crop, which is self-pollinated, contain 24% protein. According to Satish *et al*. (2018) [12], blackgram also improves soil quality by fixing up to 70–90 kg of atmospheric nitrogen per hectare. In India, it makes up roughly 13.73% of the total area planted to pulses and 13.40% of the total amount produced. In India, urad beans were grown on 5.03 million hectares of land between 2017 and 2018, yielding 3.28 million t and 653 kg/ha of productivity (Anonymous, 2018) [1]. Due to the heavy rainfall seen during the monsoon, which causes weeds to seriously destroy crops, blackgram (Vigna mungo) is typically accompanied by lush weed growth during the rainy season. Blackgram (*Vigna mungo*) is one of the important pulses grown throughout India during both in summer and rainy seasons. It is a self-pollinated leguminous crop and seeds contain 24 per cent protein. It also enriches the soil by fixing atmospheric nitrogen up to 70-90 kg/ha (Satish *et al*., 2018) [12]. It contributes about 17.13 % of the total area in pulses and 13.40 % of their total production in India. Urd bean was cultivated on an area of 5.03 m ha with a production of 3.28 m t and productivity of 653 kg/ha in India during 2017-18 (Anonymous, 2018) [1]. Blackgram (*Vigna mungo*) is usually accompanied by luxuriant weed growth during rainy season owing to abundant rainfall received during

monsoon leading to serious crop losses by weeds. Unchecked weeds have been shown to significantly reduce seed yield; for blackgram, this reduction can range from 46 to 53% in the summer (Bhandari *et al*., 2004; Kumar and Tewari, 2004) [2, 7]; in contrast, losses can range from 43.2 to 64.1% in the rainy season. (Chand and others 2004, Rathi and others 2004) [3, 11]. The first 15 to 45 days following sowing are the most vulnerable for weed competition in the crop. Furthermore, hand weeding is dangerous and unfeasible because to the season-long rain. Consequently, chemical weed control emerged as a practical and economical solution for controlling weeds in the production of black grams. Mulches were successful in keeping in-situ moisture and suppressing weeds (Uwah and Iwo, 2011) [14]. Organic matter and moisture content of the soil were observed to increase with mulching. Mulching is therefore one of the finest ways to control biotic and abiotic variables such as soil temperature, rainfall, weeds, etc., resulting in healthy crop establishment and increased water efficiency. Mulching lowers weed growth, slows down soil deterioration, and controls water evaporation. As a result, it helps to regulate temperature variations, promotes more soil moisture retention, and enhances the physical, chemical, and biological qualities of the soil. Since it enriches the soil with nutrients, it eventually improves crop development and yield (Komal *et al*., 2018) [6]. Thus, the objective of the study was to study the effect of mulching and herbicides on weed dynamics and productivity of Black gram.

Materials and Methods

The field trial was conducted in 2021 and 2022 at Krishi Vigyan Kendra (KVK) Reasi Research Farm, J&K, located at $32^0$51'41N and $74^0$41'58E at 352 meters above sea level. The soil of the experimental field was sandy clay with a high content of nitrogen, phosphorus, potassium and organic carbon. The experiment was conducted in a randomized block design with three replications. Treatment consisted of T_1: pendimethalin @ 1 kg a.i /ha, T_2: imazetapyr @ 0.075 kg a.i /ha, T_3: Quizalofop-ethyl @ 0.050 kg a.i /ha, T_4: pendimethalin @ 1 kg a.i /ha fb imatetapyr @ 0.05 kg a.i /ha a.i /ha, T_5: Pendimethalin @ 1 kg a.i /ha fb Quizalofop-ethyl @ 0.050 kg a.i /ha, T_6: Mulching, T_7: Pendimethalin @ 1 kg a.i /ha fb Mulching, T_8: Hand weeding 20 and 40 DAS, T_9: free grass and T_{10}: weed control. Black gram (PU 31) was sown with a sowing rate of 20 kg ha-1 at a distance of 30 x 10 cm. Observations of weed dynamics, plant growth parameters, e.g., plant height, plant dry matter, crop growth rate (CGR) and relative growth rate (RGR) provide evidence of yield, i.e. branches per plant, pods per plant, seeds per pod 100 seed weight and grain yield were recorded using a 0.25 m^2 in each plot and expressed as numbers in m^2.

Results and Discussion

Weed flora

The major weed flora of experimental site was *Cynodon dactylon, Cyperus rotundus, Sateria gluaca, Commelina benghalensis, Solanum nigrum, Physalis minima, Euphorbia helioscopia and Amaranthus viridus* during both the years of experimentation.

Effect on weeds

Among weed control agents, two manual weeding treatments at 20 and 40 DAS recorded significantly minimum weed count (5.71 and 5.89) and weed dry matter (2.27 and 3.03) statistically equal to pendimethalin @ 1 kg a.i /ha fb Mulching, pendimethalin @ 1 kg a.i /ha fb Imatsethapyr @ 0.075 kg a.i /ha and pendimethalin @ 1 kg a.i /ha fb Quizalofop-ethyl @ 0.050 kg a.i /ha. Significant reductions in weed numbers and weed dry matter can be attributed to effective weed control in the respective weed killers. These findings are confirmed by Raj *et al*., 2010 [10]; Chaudhari *et al*., 2016 [4]. The highest weed control efficiency was observed with two manual weeding treatments at 20 and 40 DAS followed by pendimethalin @ 1 kg a.i /ha fb mulching, pendimethalin @ 1 kg a.i /ha fb imatetapyre @ 0.075 kg a.i / ha. ha and pendimethalin @ 1 kg a.i /ha fb Quizalofop ethyl @ 0.050 kg a.i /ha. This may be due to regular herbicide use, which resulted in a significant reduction in weed numbers and ultimately a reduction in weed dry weight. Similar results were obtained by Kushwah and Vyas, 2005 [8]; Yadav *et al*., 2019 [15].

The weed index data shown in Figure1 shows that among the herbicides, black gram had the maximum yield loss of 60.22 percent as measured by weed index compared to two-hand weeding in 20 and 40 DAS which recorded 10.60% followed Pendimethalin @ 1 kg a.i /ha fb Mulching 11.69 %, Pendimethalin @ 1 kg a.i /ha fb Imazethapyr @ 0.075 kg a.i /ha 13.66 % and Pendimethalin @ 1 kg a.i /ha fb Quizalofop-ethyl @ 0.050 kg a.i /ha 14.75%.

Effect on crop growth

Among the weed management treatments two hand weeding at 20 and 40 DAS recorded significantly highest plant height, dry matter accumulation, crop growth rate (CGR) and relative growth rate (RGR) which was statistically at par with Pendimethalin @ 1 kg a.i /ha fb Mulching, Pendimethalin @ 1 kg a.i /ha fb Imazethapyr @ 0.075 kg a.i /ha and Pendimethalin @ 1 kg a.i /ha fb Quizalofop-ethyl @ 0.050 kg a.i /ha. The increase in growth parameters was due to the reduction in weed competitiveness with the crop which ultimately favored better environment for growth and development of crop. Similar findings were reported by Kaur *et al.* (2009) [5].

Effect on yield attributes and yield

During the experimentation all the growth and yield attributing characters viz., branches per plant, pods per plant, seeds per pod and 100 seed weight were found significantly higher under two hand weeding at 20 and 40 DAS which was statistically at par with Pendimethalin @ 1 kg a.i /ha fb Mulching, Pendimethalin @ 1 kg a.i /ha fb Imazethapyr @ 0.075 kg a.i /ha and Pendimethalin @ 1 kg a.i /ha fb Quizalofop-ethyl @ 0.050 kg a.i /ha. This happened due to the implementation of successful weed management technologies, weeds competed less with the crop for various resources such as space, light, nutrients, and moisture. As a result of reduced crop-weed competition, crop growth improved overall, and reproductive structures and photosynthate transfer to the sink improved. These results were in close conformity with Yadav *et al*. (2014) [16]. Among the weed management treatments seed yield (905 kg/ha) and stover yield (3129 kg/ha) were recorded significant highest two hand weeding at 20 and 40 DAS which was statistically at par with Pendimethalin @ 1 kg a.i /ha fb Mulching, Pendimethalin @ 1 kg a.i /ha fb Imazethapyr @ 0.075 kg a.i /ha and Pendimethalin @ 1 kg a.i /ha fb Quizalofop-ethyl @ 0.050 kg a.i /ha. This is likely owing to enhanced weed control of both grassy and broad-leaved weeds during early crop growth phases, increased weed control effectiveness, increased nutrient absorption by the crop, and improved yield characteristics. Increase in the number of seeds/pod, test weight and seed yield under straw mulch is due to the fact that it adds nutrients to soil though decomposition of stover and leads to better moisture availability by reducing the

water loss through evaporation and by suppressing weed growth by depriving the germinating weeds, which effected on the yield attributes of black gram. The results were in accordance with Mahale *et al*. (2018) [9].

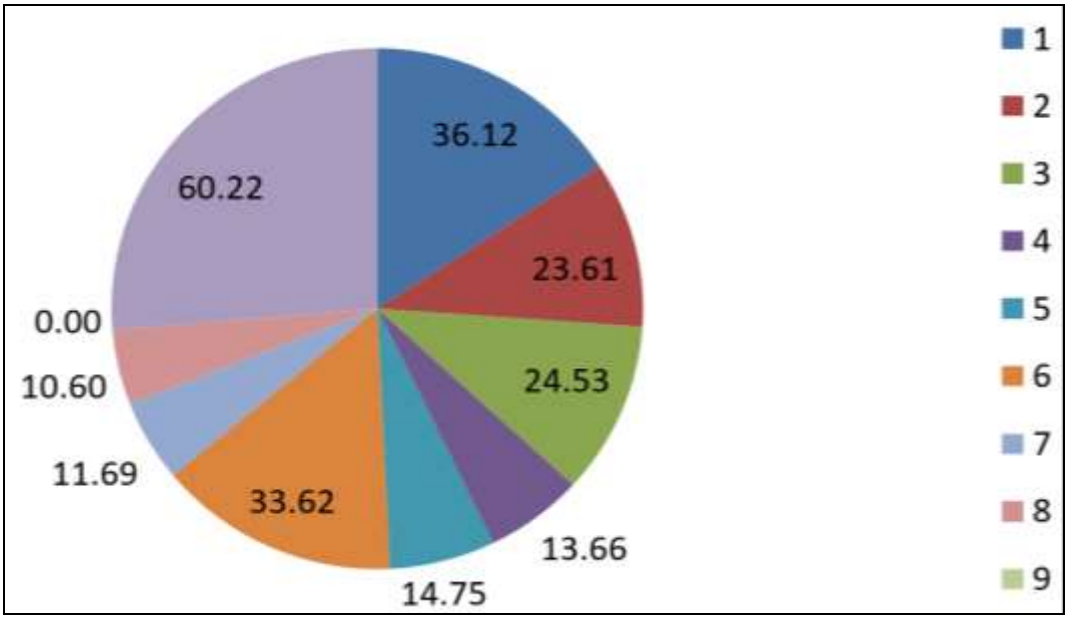

Fig 1: Effect of mulching and herbicides on weed index (%) (Pooled data of 2 years)

Table 1: Effect of mulching and herbicides on total weed density (no./m^2), weed dry matter(g/m^2) and weed control efficiency (%) (Pooled data of 2 years)

Treatment	Weed density (no./m^2)		Weed dry matter (g/m^2)		Weed control efficiency (%)	
	20 DAS	40 DAS	20 DAS	40 DAS	20 DAS	40 DAS
Pendimethalin @ 1 kg a.i /ha	6.78 (45.00)	6.83 (45.67)	3.21 (9.31)	3.73 (12.95)	64.65	70.80
Imazethapyr @ 0.075 kg a.i /ha	6.32 (39.00)	6.43 (40.33)	2.72 (6.38)	3.37 (10.39)	75.78	76.58
Quizalofop-ethyl @ 0.050 kg a.i /ha	6.38 (39.67)	6.45 (40.67)	2.76 (6.65)	3.41 (10.65)	74.77	75.99
Pendimethalin @ 1 kg a.i /ha fb Imazethapyr @ 0.075 kg a.i /ha	5.80 (32.67)	5.89 (33.67)	2.34 (4.50)	3.08 (8.50)	82.92	80.83
Pendimethalin @ 1 kg a.i /ha fb Quizalofop-ethyl @ 0.050 kg a.i /ha	5.86 (33.33)	6.0 (35.00)	2.45 (5.03)	2.71 (6.37)	80.90	85.64
Mulching	6.73 (44.33)	6.78 (45.00)	3.05 (8.31)	3.65 (12.31)	68.44	72.23
Pendimethalin @ 1 kg a.i /ha fb Mulching	5.77 (32.33)	6.0 (35.00)	2.32 (4.37)	3.05 (8.33)	83.43	81.21
Hand weeding at 20 and 40 DAS	5.71 (31.67)	5.89 (33.67)	2.27 (4.17)	3.03 (8.18)	84.19	81.56
Weed free	1.00 (0.00)	1.00 (0.00)	1.0 (0.00)	1.0 (0.00)	100	100.00
Weedy check	10.94 (118.67)	11.19 (124.33)	5.23 (26.34)	6.73 (44.34)	-	-
SEm (±)	0.09	0.08	0.04	0.04	-	-
CD (5%)	0.26	0.23	0.12	0.10	-	-

Table 2: Effect of mulching and herbicides on Plant growth parameters (Pooled data of 2 years)

Treatment	Plant height (cm)		Dry matter (g/m^2)		CGR 30-60 days (g/plant/day)	RGR 30-60 days (g/g/day)
	30 DAS	60 DAS	30 DAS	60 DAS		
Pendimethalin @ 1 kg a.i /ha	17.07	34.41	14.46	184.16	5.66	0.04
Imazethapyr @ 0.075 kg a.i /ha	19.70	36.70	15.64	205.31	6.32	0.04
Quizalofop-ethyl @ 0.050 kg a.i /ha	19.44	36.44	15.60	204.27	6.29	0.04
Pendimethalin @ 1 kg a.i /ha fb Imazethapyr @ 0.075 kg a.i /ha	21.44	39.11	16.49	222.16	6.86	0.04
Pendimethalin @ 1 kg a.i /ha fb Quizalofop-ethyl @ 0.050 kg a.i /ha	21.14	38.67	16.39	220.96	6.82	0.04
Mulching	17.22	34.56	14.93	187.67	5.76	0.04
Pendimethalin @ 1 kg a.i /ha fb Mulching	21.67	39.67	16.63	223.20	6.89	0.04
Hand weeding at 20 and 40 DAS	22.24	40.08	16.69	239.49	7.43	0.04
Weed free	24.15	43.12	18.19	258.19	8.00	0.04
Weedy check	15.13	32.46	12.51	162.51	5.00	0.04
SEm (±)	0.45	0.51	0.19	4.62	0.15	0.00
CD (5%)	1.33	1.50	0.58	13.73	0.45	0.00

Table 3: Effect of mulching and herbicides on yield and yield attributes (Pooled data of 2 years)

Treatment	No. of branches/plant	No. of pods/plant	No. of seed/pod	Test weight (g)	Seed yield (kg/ha)	Stover yield (kg/ha)
Pendimethalin @ 1 kg a.i /ha	5.83	10.00	4.33	2.28	647	2298
Imazethapyr @ 0.075 kg a.i /ha	5.93	13.67	4.67	2.68	773	2679
Quizalofop-ethyl @ 0.050 kg a.i /ha	6.24	12.67	4.67	2.65	764	2648
Pendimethalin @ 1 kg a.i /ha fb Imazethapyr @ 0.075 kg a.i /ha	6.07	16.33	5.00	3.12	874	3001
Pendimethalin @ 1 kg a.i /ha fb Quizalofop-ethyl @ 0.050 kg a.i /ha	6.05	15.67	5.00	3.09	863	2956
Mulching	6.05	10.33	4.33	2.31	672	2335
Pendimethalin @ 1 kg a.i /ha fb Mulching	6.32	17.00	5.33	3.17	894	3050
Hand weeding at 20 and 40 DAS	6.34	17.33	5.33	3.24	905	3129
Weed free	6.74	19.67	5.67	3.60	1012	3671
Weedy check	5.73	7.67	4.00	2.28	403	1459
SEm (±)	0.11	0.56	0.69	0.54	29.20	71.66
CD (5%)	0.34	1.66	2.04	1.60	86.75	212.91

Conclusion

The study highlights the significance of effective weed management strategies, such as mulching and the application of herbicides, in enhancing the growth and yield of blackgram in India. By reducing weed competition, these methods contribute to improved crop productivity and soil health, ultimately leading to better agricultural outcomes.

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