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A Study on Bio-Efficacy of Herbicides and their Impact on Weed Dynamics and Yield of Rabi Blackgram (*Vigna Mungo* L.)

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Abstract

The field experiment was conducted during *rabi*, 2016-17 and 2017-18 at Regional Agricultural Research Station, Tirupati. The experiment was laid out in randomized block design, comprising of ten treatments i.e. T_1: Clodinofop-propargyl + Na-aciflourfen@ 60 +120 g ha^{-1} ; T_2: Clodinofop-propargyl + Na-aciflourfen @ 80 +160 g ha^{-1}; T_3 : Imazethapyr @ 50 g ha^{-1} ; T_4 : Imazethapyr @ 60 g ha^{-1} T_5 : Imazethapyr @ 70 g ha^{-1} ; T_6: Imazethapyr + Imazomox @ 50 g ha^{-1} ; T_7: Imazethapyr + Imazomox @ 60g ha^{-1} ; T_8 : Imazethapyr + Imazomox @ 70 g ha^{-1} T_9 : Hand weeding at 15 and 30 DAS and T_{10} : Weedy check wiith three replications. Post emergence application of herbicides was done at 2-3 leaves stage of weeds.The lowest weed density and dry weight with highest weed control efficiency at 30 and 60 DAS were obtained with 2 HW at 15 and 30 DAS, comparable with clodinofoppropargyl 8% EC + Na aciflourfen 16.5% SL @ 80 + 160 g ha^{-1} or 60 + 120 g ha^{-1}. The post emergence application of Imazethapyr @ 50, 60 and 70 g ha^{-1} exerted phytotoxicity on blackgram as stunting, leaf crinkling and chlorotic symptoms with a scoring of 4 (moderate injury, but recovery is possible). however, Imazethapyr 35 % + Imazomox 35% @ 50, 60 and 70 g ha^{-1}also caused phytotoxicity scoring of 3. Post emergence application of clodinofoppropargyl 8% EC + Na-aceflourfen 6.5% SL @ 80 + 160 g ha^{-1}at 2-3 leaf stage of weeds found to be non-phytotoxic on blackgram with effective control of broad spectrum of weeds resulted in higher growth parameters, yield attributes and seed yield with remunerative returns, proved to be the best weed management practice in blackgram during *rabi*.

Key words : *Blackgram, weed management, post-emergence, herbicides, phytotoxicity.*

Introduction

Blackgram *(Vigna mungo L.)* is a prominent nutritious pulse crop popularly known as urd bean and the most widely cultivated pulse crop under irrigated, rainfed as well as a fallow crop after rice in many parts of India. Black gram is cultivated in 4.6 m ha with an average productivity of 533 kg ha^{-1} contributing for 2.45 m t of production whereas in Andhra Pradesh about 3.03 lakh ha with a production of 3.29 lakh tons and productivity of 1086 kgha^{-1} (agri.coop.in). Further, with release of improved varieties, the area under black gram cultivation has registered an increase in recent years (1). However, one of the constraints noticed for the poor yields of blackgram at national as well as at state level is attributed to the biotic stress due to weed menace. Weeds if not controlled in time during critical crop weed competition period (15-45 DAS) of this short duration crop, the yield is severely affected with competition from weeds for moisture, nutrients and light. As the black gram is a weak competitor with weeds, it is noticed to be affected with an yield loss of 43 percent due to unchecked weed growth (2, 3). Hence timely weed control is to be taken up for enhancing the crop productivity. Even the pre-emergence application of pendimehalin followed by hand weeding at 30 DAS is a widely recommended practice in black gram, however, continuous application of same herbicide may lead to weed shift. Further, in the present scenario of non availability of labour in time coupled with escalating labour costs is emerging as a major constraint for physical weed control. In some instances, farmers are unable to take up pre-emergence herbicidal application due to the prevailing weather situation at sowing time. Under such situations, early post-emergence application of suitable herbicides is essential to bring down the weed infestation (4). Different premix combinations of herbicides are available in market and it is considered necessary to test their bio-efficacy in related to phytotoxicity on black gram and effectiveness of weed control at different doses. Hence, the present investigation was carried out to find out suitable herbicide for post emergence application with effective control of broad spectrum of weeds without any adverse affect on black gram.

Materials and Methods

The field experiment was conducted during rabi, 2016-17 and 2017-18 at Regional Agricultural Research Station, Tirupati located at 13.27^{O} N latitude 79.36^{O} longitude and an altitude of 182.9 m above mean sea level. The experimenal soil was clay loam in texture with neutral in reaction (pH 7.48), low in organic carbon (0.34%), low in available nitrogen (205 kg ha^{-1}), high in phosphorus (81 kg ha^{-1}) and medium (285 kg ha^{-1}) in potassium status. The experiment was laid out in randomized block design,

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comprising of ten treatments i.e. T_1: Clodinofop-propargyl + Na-aciflourfen@ 60 +120 g ha^{-1}; T_2: Clodinofop-propargyl + Na-aciflourfen @ 80 +160 g ha^{-1}; T_3 : Imazethapyr @ 50 g ha^{-1}; T_4 : Imazethapyr @ 60 g ha^{-1} T_5 : Imazethapyr @ 70 g ha^{-1}; T_6: Imazethapyr + Imazomox @ 50 g ha^{-1}; T_7: Imazethapyr + Imazomox @ 60g ha^{-1} ; T_8 : Imazethapyr + Imazomox @ 70 g ha^{-1}; T_9 : Hand weeding at 15 and 30 DAS and T_{10} : Weedy check wiith three replications. The test variety of blackgram TBG 104 was sown at 30 x 10 cm during *rabi*, 2016-17 and 2017-18. Post emergence application of herbicides was done with a knap sack sprayer with 500 L $ha^{-1}$of spray volume of water and flat fan nozzle at 2-4 leaf stage of weeds (12-15 DAS). Data on weed density and dry weight m^{-2} were recorded at 30 and 60 DAS in 1 m^2 area with quadrant placement randomly in each treatment, subjected to square root transformation and statistically analysed with analysis of variance (ANOVA) technique. Weed control efficiency (WCE) was calculated at 30 and 60 DAS. The phytotoxic observations on blackgram was assessed by visual observations of crop injury at 0-10 scale. Further, the observations on crop growth, yield attributes and yield of blackgram were recorded and economics of each weed management practice was worked out.

Results and Discussion

Weed flora : The major dominant weed flora observed in the experimental field are *Trianthemaportulacastrum, Digeraarvensis, Cleome viscosa, Euphorbia hirta, Boerhaviaerecta, Amaranthusviridis, Celosia argentia* and *Trichodesmaindica among broad leaved weeds; Cynodondactylon, Dactylocteniumaegyptium, Digitarias-anguinalis, Echinochloacolona, Panicumrepens,* and *Rotoboelliacochinensis* among grasses and *Cyperus* species of sedges.

Effect on Weeds : Weed dynamics at 30 and 60 DAS was noticed to be significantly influenced by different weed control practices. Post emergence application of herbicides had invariably suppressed the weed growth and was superior over weedy check. (Table-1). The lowest weed density (3.70 and 3.33 m^{-2}) and dry weight (3.41 and 3.76 g m^{-2}) at 30 and 60 DAS respectively were recorded with two hand weedings at 15 and 30 DAS, which was however comparable with post emergence application of premix herbicide Clodinofoppropargya 8% EC + Na aciflourfen 16.5% SL @ 80 + 160 g ha^{-1} or 60 + 120 g ha^{-1}. The next better treatments were Imazethapyr 10% SL @70g $ha^{-1}$and 60 g ha^{-1}. The ready mix of Imazethapyr 35 % + Imazomox 35% @ 50, 60, and 70 g ha^{-1} did not effectively controlled *Trianthemaportulacastrum* which was one of the dominated weed and this resulted in higher weed dry weight m^{-2} compared to other herbicidal treatments.

With regard to the weed control efficiency (WCE), the highest value of 89.5 per cent at 30 DAS and 90 per cent at 60 DAS were obtained with two hand weedings at 15 and 30 DAS. Among the post-emergence application of herbicides, clodinofoppropargy 8% EC + Na aciflourfen 16.5% SL @ 80 + 160 g ha^{-1} proved to be superior with a WCE of 87.5 percent and 88.0 per cent at 30 DAS and 60 DAS respectively. This might be due to the synergistic effect of both different group of herbicides as a pre-mix combination which offered effective control of broad spectrum of weeds at early as well as later stages of crop growth. clodinofoppropargyl controls grassy weeds by inhibiting acetyl CoA carboxylase and aciflourfen controls both grassy and broad leaved weeds by inhibiting of protoporphyrinogen oxidase as also reported by (5). These results are in conformity with the findings of (6).

Effect of Phytotoxicity : The post emergence application of Imazethapyr @ 50, 60 and 70 g ha^{-1} exerted Phytotoxicity on blackgram as stunting, leaf crinkling and chlorotic symptoms. Which existed upto 15 days after application with a scoring of 4 (moderate injury, but recovery is possible). however, Imazethapyr 35 % + Imazomox 35% @ 50, 60 and 70 g ha^{-1}also caused phytotoxicity scoring of 3 in blackgram, which existed upto ten days afterapplication and recovered later.Similar results were reported by (6, 7).

Growth parameters : Blackgram crop growth parameters i.e., plant height, dry matter and number of branches $plant^{-1}$ are noticed to be significantly influenced by all the weed control practices and improved compared to weedy check. Two hand weedings at 15 and 30 DAS produced inflated growth stature comparable to post emergence application of Clodinofoppropargyl 8% EC + Na-aceflourfen 6.5% SL @ 80 + 160 g $ha^{-1}$and also 60 + 120 g ha^{-1} which might be due to effective weed control and the improved crop growth is able to suppress weeds emergence at later growth period even upto 60 DAS. Further, the crop growth was affected upto 15 days after herbicide application with Imazethapyr 10% SL @ 50,60 and 70 g ha^{-1} and also Imazethapyr 35 % +Imazomox 35% @ 50, 60 and 70 g ha^{-1} with mild toxicity which resulted in shorter plants and lesser dry matter and number of branches $plant^{-1}$. However the poor performance of crop with deflated growth parameters was noticed with weedy check due to the exploitation of available resources with uncontrolled weed growth.

Yield attributes and yield : Blackgram yield attributes i.e. number of pods $plant^{-1}$, seed and haulm yields were the highest with two hand weedings at 15 and 30 DAS. This is due to the best performance of crop under weed free situation with timely removal of weeds. Among the herbicides, post emergence application of

Table-1 : Effect of weed management practices on weed dynamics of rabi blackgram (pooled mean of 2016-17 and 2017-18).

Treatment	Weed count (no. m^2)		Weed dry matter (g. m^2)		Weed Control efficiency (%)	
	30 DAS	60 DAS	30 DAS	60 DAS	30 DAS	60 DAS
T_1	3.58 (13.16)	4.05 (16.17)	3.89 (13.18)	4.29 (16.2)	82.1	84.8
T_2	3.70 (13.66)	3.33 (10.83)	3.41 (10.32)	3.76 (12.8)	87.5	88.0
T_3	4.93 (24.0)	6.20 (39.83)	5.85 (27.35)	6.56 (35.3)	65.5	66.8
T_4	4.72 (21.99)	5.72 (33.00)	5.13 (26.10)	5.64 (32.01)	68.4	69.8
T_5	4.46 (19.66)	4.89 (23.99)	4.66 (21.35)	5.30 (27.6)	75.1	74.0
T_6	6.98 (48.66)	8.39 (70.16)	7.65 (55.90)	8.68 (71.6)	34.3	32.5
T_7	6.80 (46.16)	8.13 (66.16)	7.29 (50.20)	8.34 (65.2)	39.5	38.4
T_8	6.53 (42.66)	7.72 (60.5)	6.85 (47.24)	7.90 (61.8)	45.2	41.6
T_9	2.95 (23.66)	2.86 (8.00)	3.30 (9.56)	3.48 (10.62)	89.5	90.0
T_{10}	8.61 (74.33)	10.26 (102.2)	9.13 (84.30)	10.32 (106.1)		
SEM +	0.17	0.345	0.314	0.359		
C.D. @ 0.05	0.52	1.02	0.920	1.07		

Values in paranthesis are the original values.

Table-2 : Effect of weed management practices on growth parameters, yield attributes yield and economics of Blackgram (pooled mean of 2016-17 and 2017-18).

Treatment	Plant height (cm)	No. of branches / plant	No. of pods / plant	Dry weight / plant	Grain yield kg/ha	Haulm yield kg/ha	Net returns Rs./ha	B:C ratio
T1	32.1	4.2	28.5	17.4	1360	1809	43236	2.82
T2	32.9	4.5	29.9	17.5	1375	1816	43444	2.75
T3	28.3	3.7	25.1	15.2	1155	1558	34043	2.40
T4	26.9	3.2	24	14.5	1142	1552	30402	2.31
T5	25.1	3.1	22.3	12.9	1153	1568	33544	2.29
T6	28.9	3.4	24.7	15.5	973	1375	25582	2.04
T7	26.8	3.1	23.6	14.1	988	1395	25160	2.00
T8	25.9	3.2	22.3	12.6	1047	1466	28432	2.08
T9	33.6	4.5	30.2	18.6	1440	1871	41018	2.40
T10	23.3	2.8	18.9	12.7	676	987	12611	1.55
SEM +	0.75	0.18	0.67	0.43	40.7	48.6	1255	0.095
C.D. @ 0.05	2.23	0.53	2.0	1.28	121	145	3737	0.28

clodinofoppropargyl 8% EC + Na-aceflourfen16.5% SL @ 80 + 160 g ha^{-1} on par with 60 + 120 g ha^{-1}. The combined effect of two herbicides in premix formulation might have suppressed the growth of wide spectrum of weeds i.e. grases, sedges and broad leaved weeds during the critical crop the weed competition period, which in turn enhanced the availability of above and underground resources to crop. Thus shifting of competitive advantage towards crop resulted in improved stature of yield attributes, higher seed and haulm yields. However, the phytotoxic effect of Imazethapyr 10% SL and also premix herbicide Imazethapyr 35 % + Imazomox 35% @ 50, 60 and 70 g ha^{-1} might be the reason for inferior performance of blackgram with lesser number of pods $plant^{-1}$, seed and haulm yields.Unchecked weed intensity affected crop growth and hence recorded the lowest seed and haulm yields. The results are analogous to those reported by (8, 9).

Economics : The highest net returns and B:C ratio were obtained with post emergence application of Clodinofoppropargyl 8% EC + Na-aceflourfen 6.5% SL @ 80 + 160 g ha^{-1}followed by 60 + 120 g ha^{-1} due to the higher seed and haulm yields. Though two hand weedings at 15 and 30 DAS resulted in higher yield compared to herbicidal application, the net returns and B:C ratio was lower due to the cost of cultivation incurred for two hand weedings with the escalated labour charges.

Conclusions

Among the various herbicides tried at different doses, post emergence application of clodinofoppropargyl 8% EC + Na-aceflourfen 6.5% SL @ 80 + 160 g ha^{-1}at 2-3 leaf stage

of weeds found to be non-phytotoxic on blackgram and with effective control of broad spectrum of weeds resulted in higher yield with remunerative returns, proved to be the best weed management practice in blackgram during *rabi*.

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