

Original Research Article

Effect of Plastic Mulch and Herbicides on Weed Dynamics and Productivity of Red Gram

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ABSTRACT

A field experiment was conducted in Birsa Agricultural University, Ranchi during *Kharif* seasons of 2015 and 2016 to find out the effect of plastic mulch and herbicides on weed dynamics and productivity of red gram. The treatments comprised of post-emergence application of sodium acifluorfen 16.5% + clodinfop- propargyl 8% (Iris) 1 kg/ha, imazathapyre 0.05 kg/ha, plastic mulch (transparent), plastic mulch (black), hand weeding at 25, and 50 days after sowing (DAS) and weedy check. The result revealed that Iris 1 kg/ha post emergence similar to plastic mulch (black) recorded reduced weed dry matter of all species of broad leaved, grassy weed and sedges at 30 and 60 DAS, Application of Iris 1 kg/ha post emergence and plastic mulch (black) were similar to each other in producing higher plant height, number of pods/plant, number of grains per pod and 100 seed weight of red gram compared to imazathapyre 0.05 kg/ha post emergence, hand weeding at 25, and 50 DAS, plastic mulch (transparent) and weedy check during both the years. Application of Iris 1 kg/ha post emergence similar to application of imazathapyre 0.05 kg/ha post emergence in producing higher B: C ratio compared to rest of the treatments during both the years of experimentations.

Keywords

Mulch,
Herbicide,
Weed
dynamics, Iris,
Imazathapyre

Introduction

India is producing 14.76 million tons of pulses from an area of 23.63 million hectare, which is one of the largest pulses producing countries in the world. However, about 2-3 million tons of pulses are imported annually to meet the domestic consumption requirement. Thus, there is need to increase production and productivity of pulses in the country by more intensive interventions. The area, production and productivity of pigeon pea in Jharkhand comprises of 0.112 million ha, 0.076 million tones and 679 kg/ha, respectively. Pigeon pea being a *Kharif* season crop is highly infested with narrow

and broad leaved weeds. Timely weed control is very essential for realization of yield potential of pigeon pea. Due to wider row spacing and initial slow growth of pigeon pea, weeds pose a major problem to its productivity which may lead to its yield reduction up to 80%. Manual and mechanical methods of weed control are quite effective, but they are costly and time consuming. However, due to frequent rains it becomes difficult to perform hand weeding at proper time. Under given circumstances farmers need alternate production system using chemical and

cultural weed management that are more efficient, less labour-intensive and offer a quick response enabling farmers to produce more at less costs. Mulching as a weed control method is used in agriculture throughout the world (Gupta, 1991). Mulching can reduce weed competition against crops, and save fuel and labour costs for weed control. Covering the soil surface with suitable mulch can reduce weed seed germination. Shading physically hinders emerging weeds, enhance crop growth and competitiveness by conserving soil moisture and sometimes by modifying soil temperature (Sharma and Acharya, 2000; Edwards *et al.*, 2000). Hence to find out the best method for controlling weeds in pigeon pea to get maximum profit this experiment has been carried out.

Materials and Methods

A field experiment was carried out during *Kharif* season of 2015 and 2016 at agronomical research farm of Birsa Agricultural University Ranchi, Jharkhand. The soil of experimental plot was sandy loam in texture having pH 6.4, organic carbon 0.40%, and available N 195, P 17.4 and K 178.3 kg/ha respectively. The experiment was laid out in randomized complete block design with three replications involving 10 treatments.

Treatments consisted of application of Iris (Sodium acifluorfen 16.5% + clodinofofop-propargyl 8%) EC 1 kg/ha post-emergence, imazathapyre 0.05 kg/ha post emergence, plastic mulch (transparent), plastic mulch (black), hand weeding at 25, and 50 days after sowing and weedy check. The plastic mulch of 1.2 meter width was stretched in field at 30 cm equidistance. Prior to laying the plastic mulch the sheets were folded at 15 cm and two slits were made at the margin at a spacing of 70 cm. This resulted mark on

the plastic mulch at a distance of 30 cm for maintaining plant to plant distance at 30 cm. The seeds of red gram variety Bahar was dibbled in the hole of plastic mulches. The seeds under rest of the treatments were sown at a spacing of 70 cm row to row and 30 cm plant to plant. The herbicides were applied as post-emergence at 20 days after sowing using knapsack sprayer fitted with flat fan nozzle by mixing 500 litres of water per ha.

The crop was fertilized with 25, 50 and 40 kg/ha of nitrogen, phosphorus and potassium through di ammonium phosphate, urea and muriate of potash. The entire amount of fertilizer was applied after field preparation in the furrows. Observations taken on weeds were transformed into square root transformation with formula $\sqrt{(x+0.5)}$ for uniformity.

Results and Discussion

Effect on weeds

Weed density

Application of sodium acifluorfen 16.5% + clodinofofop-propargyl 8% 1 kg/ha post emergence recorded significantly reduced weed density of all species of weeds under grassy, broad leaved and sedges at 30 and 60 days after sowing (DAS). However, this treatment was similar to imazathapyre 0.05 kg/ha post emergence and black plastic mulch in controlling *Alternanthera sessilis* and to transparent plastic mulch in controlling *Cyperus rotundus* and *Paspalum distichum* at 30 and 60 DAS. Sodium acifluorfen 16.5% + clodinofofop-propargyl 8% 1 kg/ha post emergence also similar to application of imazathapyre 0.05 kg/ha post emergence, plastic mulch (black and transparent) and hand weeding in controlling *Digitaria sanguinalis* at 30 and 60 DAS compared to weedy check.

Table.1 Effect of weed control methods on weed density of broad leaf and sedges (no./m²) in red gram (pool of 2015 and 2016)

Treatments	Weed species													
	<i>Ageratum conyzoides</i>		<i>Stellaria media</i>		<i>Spilanthes acmella</i>		<i>Alternanthera sessilis</i>		<i>Aescheomene indica</i>		Total BLW		<i>Sedges Cyperus rotundus</i>	
	30 DAS	60 DAS	30 DAS	60 DAS	30 DAS	60 DAS	30 DAS	60 DAS	30 DAS	60 DAS	30 DAS	60 DAS	30 DAS	60 DAS
Iris 1 kg/ha (formulation)	1.22 (1.38)	1.33 (1.77)	1.33 (1.42)	1.49 (1.97)	0.85 (0.27)	0.88 (0.35)	0.99 (0.56)	1.09 (0.83)	0.85 (0.27)	0.88 (0.35)	2.07 (3.92)	5.74 (32.52)	1.32 (1.38)	1.48 (1.90)
Imazathapyre 0.05 kg/ha	3.33 (10.67)	3.87 (14.59)	3.07 (8.95)	3.56 (12.28)	1.77 (2.73)	2.02 (3.74)	1.47 (2)	1.69 (2.91)	1.79 (2.82)	2.04 (3.85)	5.25 (27.19)	6.38 (40.38)	2.30 (5.06)	2.68 (7.20)
Plastic mulch (Transparent)	2.44 (5.54)	2.81 (7.49)	2.52 (5.91)	2.92 (8.22)	2.65 (6.71)	3.09 (9.36)	1.88 (3.26)	2.16 (4.50)	1.47 (1.7)	1.66 (2.33)	4.86 (23.13)	7.44 (55.09)	1.54 (2.16)	1.73 (2.93)
Plastic mulch (Black)	2.32 (5.087)	2.69 (7.163)	3.07 (8.99)	3.58 (12.48)	1.41 (1.71)	1.60 (2.44)	1.26 (1.42)	1.43 (2.11)	1.33 (1.43)	1.49 (1.96)	4.32 (18.65)	5.18 (26.79)	2.02 (3.66)	2.33 (5.05)
Hand Weeding	3.67 (13.18)	3.63 (12.76)	3.16 (9.51)	3.90 (14.80)	2.86 (7.81)	3.20 (9.79)	3.01 (8.63)	3.33 (10.7)	2.40 (5.3)	2.61 (6.45)	6.69 (44.45)	7.00 (48.60)	2.51 (5.85)	2.82 (7.60)
Weedy check	3.72 (13.51)	4.35 (18.83)	3.42 (11.26)	3.98 (15.50)	3.07 (8.94)	3.57 (12.30)	3.37 (10.95)	3.91 (14.94)	2.52 (5.86)	2.91 (8.05)	7.13 (50.53)	8.71 (76.05)	2.51 (5.88)	2.91 (8.01)
SEm±	0.24	0.30	0.13	0.18	0.21	0.23	0.25	0.28	0.15	0.20	0.23	0.13	0.23	0.30
CD (P=0.05)	0.60	0.75	0.32	0.45	0.52	0.58	0.62	0.69	0.38	0.51	0.57	0.33	0.57	0.75

Table.2 Effect of weed control methods on weed density of grassy weed (no./m²) in red gram (pool of 2015 and 2016)

Treatments	Weed species													
	<i>Echinochloa crusgali</i>		<i>Dectyloctanum aegypticum</i>		<i>Panicum repens</i>		<i>Paspalam distichum</i>		<i>Digitaria sanguinalis</i>		<i>Sorgham halepens</i>		Total Grassy	
	30 DAS	60 DAS	30 DAS	60 DAS	30 DAS	60 DAS	30 DAS	60 DAS	30 DAS	60 DAS	30 DAS	60 DAS	30 DAS	60 DAS
Iris 1 kg/ha (formulation)	1.23 (1.13)	1.36 (1.50)	1.57 (2.23)	1.81 (3.20)	1.26 (1.38)	1.42 (2.04)	1.26 (1.38)	1.35 (1.77)	1.64 (2.55)	1.89 (3.63)	1.09 (0.86)	2.12 (5.12)	3.15 (9.56)	4.12 (17.28)
Imazathapyre 0.05 kg/ha	4.14 (16.68)	4.82 (22.80)	2.72 (7)	3.16 (9.68)	2.87 (8.17)	3.33 (11.14)	1.77 (2.75)	2.04 (3.84)	1.83 (3.41)	2.11 (4.92)	1.79 (3.29)	4.09 (21.85)	6.31 (39.4)	8.52 (74.26)
Plastic mulch (Transparent)	4.02 (16.08)	4.72 (22.55)	2.15 (4.20)	2.48 (5.78)	2.43 (6.00)	2.84 (8.61)	1.63 (2.2)	1.85 (3.00)	1.76 (2.80)	2.01 (3.76)	1.68 (2.50)	3.85 (16.62)	5.70 (32.71)	7.60 (60.34)
Plastic mulch (Black)	2.20 (4.5)	2.55 (6.37)	2.39 (5.36)	2.78 (7.52)	2.80 (7.75)	3.23 (10.36)	2.16 (4.23)	2.50 (5.85)	2.60 (6.36)	3.01 (8.71)	2.64 (6.64)	6.22 (42.82)	5.74 (32.65)	8.87 (81.66)
Hand Weedingnd	4.49 (19.92)	5.05 (25.36)	2.93 (8.08)	4.10 (16.42)	3.22 (10.54)	4.35 (18.97)	2.56 (6.18)	3.64 (12.85)	2.89 (7.83)	4.54 (21.01)	2.67 (6.68)	6.27 (43.51)	7.57 (57.33)	11.69 (138.14)
Weedy check	5.38 (28.68)	6.30 (39.82)	3.67 (13.06)	4.27 (17.81)	4.10 (16.46)	4.79 (22.76)	3.37 (10.87)	3.92 (14.93)	5.44 (43.55)	6.22 (55.31)	3.23 (10)	7.21 (59.33)	10.77 (120.44)	14.33 (209.98)
SEm±	0.24	0.31	0.20	0.23	0.37	0.41	0.22	0.24	0.96	1.05	0.26	0.58	0.59	0.58
CD (P=0.05)	0.58	0.78	0.50	0.57	0.90	1.01	0.54	0.60	2.37	2.60	0.65	1.42	1.47	1.44

Table.3 Effect of weed control methods on weed dry matter of broad leaf and sedges (g/m²) in red gram (pool of 2015 and 2016)

Treatments	Weed species													
	<i>Ageratum conyzoides</i>		<i>Stellaria media</i>		<i>Spilanthes acmella</i>		<i>Alternanthera sessilis</i>		<i>Aescheomene indica</i>		Total BLW		<i>Sedges Cyperus rotundus</i>	
	30 DAS	60 DAS	30 DAS	60 DAS	30 DAS	60 DAS	30 DAS	60 DAS	30 DAS	60 DAS	30 DAS	60 DAS	30 DAS	60 DAS
Iris 1 kg/ha (formulation)	0.98 (0.62)	1.84 (14.43)	1.07 (0.73)	1.32 (1.50)	0.78 (0.12)	0.84 (0.24)	0.85 (0.25)	0.96 (0.49)	0.78 (0.12)	0.83 (0.22)	1.50 (1.85)	4.11 (16.90)	1.03 (0.59)	1.32 (1.41)
Imazathapyre 0.05 kg/ha	2.31 (5.11)	3.30 (11.18)	2.13 (4.20)	2.88 (8.23)	1.26 (1.08)	1.77 (2.64)	1.15 (1.02)	1.72 (2.74)	1.35 (1.42)	1.82 (3.05)	3.57 (12.85)	5.19 (27.86)	1.63 (2.37)	2.21 (4.83)
Plastic mulch (Transparent)	1.70 (2.45)	2.36 (3.20)	1.79 (2.86)	2.39 (5.68)	1.84 (3.06)	2.77 (7.61)	1.30 (1.20)	1.77 (2.69)	1.14 (0.85)	1.52 (1.97)	3.27 (10.44)	4.54 (21.17)	1.10 (0.77)	1.41 (1.66)
Plastic mulch (Black)	1.66 (2.47)	2.29 (11.18)	2.13 (4.28)	2.90 (8.44)	1.12 (0.89)	1.46 (2.07)	1.02 (0.70)	1.53 (2.18)	1.10 (0.77)	1.40 (1.65)	2.97 (9.13)	4.91 (25.55)	1.47 (1.77)	2.01 (3.89)
Hand Weedingnd	2.40 (5.75)	3.81 (5.39)	2.27 (4.82)	3.10 (9.42)	1.99 (3.70)	2.58 (6.35)	2.06 (3.96)	2.73 (7.35)	1.57 (2.04)	1.99 (3.56)	4.44 (20.28)	5.65 (32.09)	1.67 (2.36)	2.43 (5.51)
Weedy check	2.56 (6.48)	4.60 (5.25)	2.38 (5.46)	3.25 (10.82)	2.12 (4.14)	3.19 (9.93)	2.34 (5.26)	3.34 (11.26)	1.76 (2.67)	2.53 (6.17)	4.83 (24.03)	6.49 (43.44)	1.78 (2.78)	2.45 (5.78)
SEm±	0.22	0.27	0.11	0.19	0.15	0.25	0.19	0.26	0.10	0.19	0.23	0.26	0.17	0.25
CD (P=0.05)	0.54	0.68	0.27	0.47	0.38	0.62	0.47	0.65	0.25	0.46	0.56	0.65	0.42	0.61

Table.4 Effect of weed control methods on weed dry matter (g/m²) in red gram (Grassy weeds) pool of 2015 and 2016

Treatments	Weed species													
	<i>Echinochloa crusgali</i>		<i>Dectyloctanum aegypticum</i>		<i>Panicum repens</i>		<i>Paspalam distichum</i>		<i>Digitaria sanguinalis</i>		<i>Sorgham halepens</i>		Total Grassy	
	30 DAS	60 DAS	30 DAS	60 DAS	30 DAS	60 DAS	30 DAS	60 DAS	30 DAS	60 DAS	30 DAS	60 DAS	30 DAS	60 DAS
Iris 1 kg/ha (formulation)	1.03 (0.6)	1.11 (0.78)	1.18 (1.01)	1.42 (1.79)	0.99 (0.57)	1.36 (1.52)	1.02 (0.65)	1.28 (1.5)	1.25 (1.27)	1.73 (3.13)	0.96 (0.48)	1.61 (2.55)	2.19 (4.59)	3.4 (11.26)
Imazathapyre 0.05 kg/ha	2.8 (7.5)	3.28 (10.5)	1.9 (3.28)	2.38 (5.5)	2.02 (3.98)	2.09 (4.25)	1.27 (1.14)	1.66 (2.34)	1.37 (1.69)	2.42 (5.93)	1.29 (1.41)	2.28 (5.13)	4.25 (18.14)	5.52 (31.23)
Plastic mulch (Transparent)	1.57 (2.12)	1.78 (2.86)	1.7 (2.6)	2.13 (4.5)	1.92 (3.37)	1.98 (3.44)	1.57 (2.09)	2.07 (3.96)	1.79 (2.76)	2.62 (6.55)	1.81 (2.87)	2.71 (7.11)	3.85 (14.82)	5.04 (25.64)
Plastic mulch (Black)	2.77 (7.83)	3.22 (10.48)	1.54 (1.97)	1.9 (3.32)	1.75 (3.12)	2.12 (4.8)	1.18 (0.9)	1.52 (1.85)	1.31 (1.34)	1.79 (2.97)	1.26 (1.17)	1.75 (2.82)	3.89 (15.84)	4.9 (24.86)
Hand Weedingnd	3.02 (8.71)	3.76 (13.83)	2.2 (4.5)	2.88 (7.89)	2.5 (5.94)	2.74 (7.69)	2.12 (4.11)	2.89 (8.24)	2.92 (11.39)	2.2 (4.86)	2.04 (3.72)	2.75 (7.28)	6.01 (37.5)	6.84 (47.36)
Weedy check	3.6 (12.82)	4.21 (17.5)	2.5 (5.88)	3.15 (9.63)	2.78 (7.52)	3.17 (10.6)	2.31 (4.97)	3.18 (10.01)	3.79 (21.48)	5.53 (44.57)	2.2 (4.43)	3.3 (10.44)	7.23 (56.1)	9.67 (99.98)
SEm±	0.19	0.19	0.15	0.18	0.25	0.31	0.14	0.20	0.73	0.96	0.16	0.30	0.47	0.67
CD (P=0.05)	0.46	0.46	0.37	0.43	0.62	0.78	0.34	0.49	1.80	2.37	0.39	0.75	1.17	1.66

Table.5 Effect of weed management on yield attributing characters and yield of red gram

Treatments	Plant height		No. of pods/plant		No. of grains per pod		100 seed weight		Seed yield (kg/ha)		Gross return (Rs/ha)		Net Return (Rs/ha)		B:C Ratio	
	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
Iris 1 kg/ha (formulation)	238	193	142	115	6.65	5.75	8.35	6.75	2185	1772	101057	81955	83382	64280	4.72	3.64
Imazathepyre 0.05 kg/ha	219	177	105	85	4.60	3.75	7.66	6.19	1755	1420	81163	65675	64718	49230	4.38	3.36
Plastic mulch (Transparent)	221	179	116	94	4.99	4.00	7.87	6.36	1843	1495	85250	69144	68245	52139	4.01	3.07
Plastic mulch (Black)	234	189	133	108	6.56	5.75	8.11	6.53	2036	1650	94165	76313	7920	-9933	0.09	-0.12
Hand Weedingnd	211	171	101	82	4.30	3.50	7.55	6.11	1644	1326	76012	61339	46017	31344	1.53	1.04
Weedy check	171	139	84	68	3.66	3.00	7.31	5.91	912	732	42188	33843	27193	18848	1.81	1.26
SEm±	5.97	4.71	4.61	3.48	0.36	0.33	0.15	0.12	54	53	2475	2448	2475	2448	0.18	0.16
CD (P=0.05)	14.79	11.65	11.41	8.61	0.88	0.81	0.38	0.30	132	131	6124	6058	6124	6058	0.44	0.40

Application of sodium acifluorfen 16.5% + clodinafop-propargyl 8% 1 kg/ha reduced total grassy weed population at 30 and 60 DAS by 92.06% and 91.77% and sedges by 76.53% and 76.28% compared to weedy check. Jha *et al.*, (2014) also observed application of sodium acifluorfen 16.5% + clodinafop-propargyl 8% is similar to imazathapyre in controlling weeds in soybean.

Hand weeding is not as much effective as chemical herbicide as some weeds found left in the field because of human inefficiency. Whereas plastic mulch (black) having efficient weed suppressing capability Pramanik *et al.*, (2006) have also reported that plastic mulch (black) reduced weed density in onion crop.

Weed dry matter

Application of sodium acifluorfen 16.5% + clodinafop-propargyl 8% 1 kg/ha post emergence recorded reduced weed dry matter of all species of grassy, broad leaved and sedges weeds at 30 and 60 days after sowing (DAS). However it was similar to imazathapyre 0.05 kg/ha post emergence and black plastic mulch in case of *Stellaria media*, *Alternanthera sessilis*, *Cyperus rotundus* and to black plastic mulch in case of *Ageratum conyzoides*, *Spilanthes acmella*, *Aeschynomene* and total broad leaved weeds at 30 and 60 DAS. Similarly this was similar to imazathapyre 0.05 kg/ha post emergence and black plastic mulch in case of *Panicum repens* at 60 DAS, *Paspalum distichum*, *Digitaria sanguinalis*, and *Sorghum halepense* and total grassy weeds at 30 and 60 DAS.

Application of sodium acifluorfen 16.5% + clodinafop-propargyl 8% 1 kg/ha reduced total broad, grassy weed and sedges dry matter by 92.30%, 91.82 and 78.78% at 30

DAS and 61.10%, 88.74% and 75.61% at 60 DAS respectively, compared to weedy check.

Effect on yield attributes and yield

Application of sodium acifluorfen 16.5% + clodinafop-propargyl 8% 1 kg/ha post emergence recorded similar to black plastic mulch in producing higher plant height, number of pods/plant, number of grains per pod and 100 seed weight of red gram compared to rest of the treatments during both the years. Application of sodium acifluorfen 16.5% + clodinafop-propargyl 8% 1 kg/ha post emergence produced 139.58% and 142.08% more seed yield during 2015 and 2016 compared to weedy check. This treatment was similar with black plastic mulch in 2016 in producing higher seed yield and thereby gross return. Lowest yield and yield attributes was recorded in weedy check mainly due to high plant-weed competition for light, space, moisture and nutrients (Kalpana and Velayutham, 2004). Plastic mulch (black) inducing higher plant growth and producing higher yield was not cost effective owing to higher cost of material.

Economics

Significantly maximum net return was recorded with application of sodium acifluorfen 16.5% + clodinafop-propargyl 8% 1 kg/ha post emergence, while this treatment was similar to imazathapyre 0.05 kg/ha post emergence in recording higher B:C ratio compared to rest of the treatments during both the years of experimentations (Jha *et al.*, 2014). Application of sodium acifluorfen 16.5% + clodinafop-propargyl 8% 1 kg/ha post emergence recorded 160.77 and 188.89% increase and imazathapyre 0.05 kg/ha post emergence recorded 141.99 and 166.67% increase over weedy check

during 2015 and 2016 respectively. This might be due to broad spectrum weed control provides plant to grow in competition free environment with less input cost.

Application of sodium acifluorfen 16.5% + clodinafop-propargyl 8% 1 kg/ha post emergence and imazathapyr 0.05 kg/ha post emergence can be considered as appropriate option for broad spectrum weed suppression as well as higher B: C ratio.

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