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Weeds and crop productivity of maize + blackgram intercropping system in Chhattisgarh plains

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ABSTRACT

Field experiments were conducted to study the effect on weeds and crop yield under maize + blackgram intercropping system at Raipur during 2004 and 2005. Treatments consisted of five planting geometry *viz*., sole maize, sole blackgram, maize +blackgram (1:1), maize + blackgram (2:1) and maize + blackgram (2:2) and four weed management practices *viz*., weedy check, hand weeding (HW) at 30 DAS, alachlor 2.0 kg/ha as pre-emergence and alachlor 1.5 kg/ha as pre-emergence + HW at 40 DAS. Grain yield, productivity rating index (PRI), production efficiency (PE) and weed-control efficiency (WCE) were the highest under maize + blackgram (2:1) for maize. However, weed smothering efficiency of maize was highest under maize + blackgram (1:1). At harvest of blackgram (75 DAS) and maize (105 DAS), the dry weight of weeds were the lowest with alachlor 1.5 kg/ha + HW at 40 DAS. This treatment produced maximum grain yield, PRI and PE of maize and blackgram.

Key words: Intercropping, Maize+blackgram, Weed management

Weed management in intercropping system needs concentrated scientific efforts to provide weed-free environment to both the crop components. The development of wide-spectrum herbicides in the past has opened up excellent opportunities for chemical weed control in component crops of differential nature growing in association with each other. Alachlor, a broad-spectrum herbicide, could be safely used in different intercropping system for controlling dicot and monocot weeds. It would help a great deal to boost the growth and development and finally the productivity of maize and blackgram. Physical manipulations of the intercrop environment for weed control very closely resemble those used for sole crops. Several researchers have suggested that more competitive crop cover and high plant density available in intercropping caused severe competition with weeds and reduce weed growth. Intercropping has potential as a means of weed control because it offers the possibility of a mixture of crops capturing a great share of available resources than in monocropping. The wider row spacing in maize can be used to grow short duration legumes which not only will act as smother crop, but will give additional yield. Weed control approach involving intercropping, herbicides and non- chemical method in maize and maize based intercropping system is very important to provide effective and acceptable weed control for realizing high production (Shah *et al.* 2011). Besides, intercropping also reduces weeding cost and realizes higher total productivity of the system and monetary returns (Pandey and Prakash 2002). But this system alone is not sufficient to ensure adequate weed control because of varied canopy coverage by the intercrops. Planting geometry, which modifies the crop canopy structure and micro-climate, in combination with weed management practices, may influence the weed infestation to a great extent. Hence, an integrated approach is needed to control weeds through manual and chemical weeding in an intercropping system.

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MATERIALS AND METHODS

Field experiments were conducted at the Instructional cum Research Farm of Indira Gandhi Krishi Vishwavidyalaya, Raipur (Chhattisgarh) during *Kharif* season of 2004 and 2005. The treatments consisted of five planting geometry, *viz*., sole maize (45 cm), sole blackgram (30 cm), maize (45 cm) + blackgram (1:1), maize (30 cm) + blackgram (2:1) and maize (30 cm) + blackgram (2:2) and four weed management practices, *viz*., weedy check, HW at 30 DAS, alachlor 2.0 kg/ha as pre-emergence and alachlor 1.5 kg/ha as pre-emergence + HW at 40 DAS laid out in split plot design with three replication. The soil was clayey (Vertisols) with pH 7.2, EC 0.12 ds/m, and available N, P and K of 216, 12.1 and 366 kg/ha, respectively. Application of fertilizer in sole maize was 100:60:40 kg N: P_2O_5:K_2O/ha, whereas in case of sole blackgram, was 20:40:20 kg N: P_2O_5:K_2O/ha. The composite maize '*Navjot*' and blackgram '*TAU-2*' was sown with the gross plot size of 37.8 m^2. Herbicides were applied as per the treatments. Weedy plots remained

infested with native population of weeds till harvest. The test herbicide alachlor, is an aniline herbicide used to control annual grasses and broad leaved weeds in maize, blackgram and other crops. It is a selective systemic herbicide, absorbed by germinating shoots and by roots. The productivity rating index (PRI) pertaining to maize crop was worked out to judge the performance of the treatments. The yield of the crop under a particular treatment (t/ha) divided by standard yield of the crop (t/ha) with multiplication of hundred. production efficiency (PE) was calculated by dividing grain yield (kg/ha) with duration of the crop (Tomar and Tiwari 1990).

RESULTS AND DISCUSSION

Effect on weeds

Alternanthera triandra, Cyperus rotundus, Cynodon dactylon, and *Cynotis axillaries* were predominant weeds (Table 1). At 75 DAS, planting geometry showed significant effect on dry matter production of all species of weed. It was observed that sole maize resulted in the highest weed dry matter production which was significantly higher than rest of the treatments. Sole blackgram recorded the lowest dry matter production of *Alternanthera triandra* and *Brachiaria ramosa*, whereas maize + blackgram (1:1) registered the lowest dry matter production of *Cynotis axillaries, Cynodon dactylon,* and *Cyperus rotundus*. The weed suppression was about the same as that obtained with two HW. Kurchania *et al.* (1995) and Dubey (1998) also reported similar findings. As regards to weed management practices, the lowest weed dry matter production was recorded with alachlor 1.5 kg/ha + HW at 40 DAS, which was significantly superior to rest of the treatments. The highest dry matter production was observed under weedy check. At harvest of maize, *Alternanthera triandra, Cynotis axillaries, Cynodon dactylon, Brachiaria ramosa* and *Cyperus rotundus* were found dominant, and the dry matter production of these weed species was significantly influenced due to planting geometry (Table 2). Highest weed dry matter production was observed under sole maize, which was significantly higher than other treatments. Alachlor 1.5 kg/ha + HW at 40 DAS registered the lowest amount of dry matter production of all species of weeds. It showed that the integrated approach was more beneficial in controlling weeds than the HW or chemical approach alone (Chandel *et al.* 1995, Vairavan *et al.* 1997). Several workers also found that the intercropping maize and legumes considerably reduced the weed density compared with the monocropping maize by decrease in available light for weeds compared to mono crops. Evidence of better weed control was reasonably clear where intercropping provides a more

Table 1. Species-wise dry matter of weeds (g/m²) at harvest of blackgram as influenced by planting geometry and weed management in maize + blackgram intercropping system

Treatment	*Alternanthera triandra*		*Cynotis axillaris*		*Cynodon dactylon*		*Brachiaria ramosa*		*Cyperus rotundus*		Others	
	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005
Planting geometry												
Maize sole	4.82	4.04	1.92	1.99	1.92	1.99	2.64	3.11	4.17	3.91	3.48	3.56
	(26.05*)	(19.25)	(3.71)	(4.00)	(3.87)	(4.13)	(8.68)	(9.97)	(20.34)	(16.91)	(13.07)	(13.67)
Blackgram soles	3.41	3.28	1.93	1.94	1.90	1.89	2.19	2.17	3.28	3.03	2.73	2.71
	(14.64)	(13.98)	(3.72)	(3.79)	(3.69)	(3.57)	(5.34)	(5.34)	(12.49)	(10.51)	(8.14)	(7.83)
Maize + blackgram (1:1)	4.24	4.01	1.58	1.55	1.70	1.71	2.33	2.36	2.82	2.86	2.89	2.94
	(21.18)	(19.40)	(2.25)	(2.19)	(2.94)	(2.81)	(6.13)	(6.13)	(9.60)	(9.68)	(9.05)	(9.23)
Maize + blackgram (2:1)	4.43	4.51	1.87	1.78	1.79	1.78	2.48	2.57	3.83	3.59	3.21	3.33
	(22.80)	(23.80)	(3.43)	(3.04)	(3.26)	(3.15)	(7.12)	(7.29)	(16.80)	(14.33)	(11.28)	(11.74)
Maize + blackgram (2:2)	3.83	3.67	1.69	1.66	1.71	1.73	2.43	2.48	3.43	3.35	3.04	3.12
	(18.45)	(17.04)	(2.71)	(2.65)	(2.87)	(2.90)	(6.71)	(6.91)	(13.75)	(12.76)	(10.02)	(10.23)
LSD (P=0.05)	0.260	0.250	0.085	0.079	0.090	0.090	0.137	0.142	0.204	0.197	0.170	0.177
Weed management												
Weedy check	7.28	7.09	2.75	2.72	3.05	2.97	4.30	4.19	5.81	5.48	4.83	4.77
	(52.86)	(50.01)	(7.14)	(7.00)	(8.88)	(8.40)	(18.09)	(17.16)	(33.70)	(29.75)	(22.99)	(22.49)
Hand weeding at 30 DAS	3.29	2.95	1.54	1.49	1.37	1.41	1.89	2.31	3.79	3.40	2.10	2.24
	(10.61)	(8.47)	(1.88)	(1.75)	(1.39)	(1.52)	(3.07)	(5.05)	(14.29)	(11.27)	(3.92)	(4.55)
Alachlor 2.0 kg/ha	3.83	3.62	1.89	1.92	1.63	1.70	2.35	2.27	3.05	2.93	3.31	3.35
	(14.46)	(12.94)	(3.13)	(3.23)	(2.17)	(2.40)	(5.20)	(4.76)	(8.94)	(8.19)	(10.54)	(10.83)
Alachlor 1.5 kg/ha + HW	2.19	1.94	1.00	1.02	1.16	1.19	1.12	1.38	1.37	1.57	2.04	2.16
at 40 DAS	(4.57)	(3.35)	(0.51)	(0.55)	(0.86)	(0.93)	(0.82)	(1.53)	(1.45)	(2.13)	(3.80)	(4.28)
LSD (P=0.05)	0.188	0.178	0.070	0.071	0.073	0.073	0.109	0.109	0.156	0.146	0.132	0.133

*Original values are given in parentheses

Table 2. Species-wise dry matter of weeds (g/m²) at harvest of maize (105 DAS) as influenced by planting geometry and weed management in maize + blackgram intercropping system

Treatment	*Alternanthera triandra*		*Cynotis axillaris*		*Cynodon dactylon*		*Brachiaria ramosa*		*Cyperus rotundus*		Others	
	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005
Planting geometry												
Maize sole	6.11	5.90	2.50	2.55	2.35	2.54	4.64	4.78	4.38	4.64	4.27	4.32
	(39.71)	(37.14)	(6.29)	(6.62)	(5.92)	(6.82)	(22.75)	(23.25)	(23.17)	23.57	(18.63)	(19.07)
Blackgram sole	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	0.00	(0.00)	(0.00)
Maize + blackgram (1:1)	4.90	4.77	2.09	2.08	2.12	2.20	3.59	3.61	3.57	3.75	3.55	3.71
	(26.35)	(25.16)	(4.25)	(4.19)	(4.60)	(4.95)	(13.99)	(13.79)	(16.34)	16.90	(12.61)	(13.77)
Maize + blackgram (2:1)	5.27	5.25	2.36	2.41	2.26	2.47	4.18	4.37	4.00	4.26	4.10	4.20
	(30.42)	(30.78)	(5.51)	(5.93)	(5.45)	(6.39)	(18.64)	(20.33)	(20.06)	20.19	(17.38)	(18.10)
Maize + blackgram (2:2)	4.89	4.94	2.24	2.28	2.17	2.30	3.90	3.93	3.82	3.79	3.98	4.04
	(27.16)	(27.83)	(4.94)	(5.15)	(4.91)	(5.50)	(16.35)	(16.27)	(18.55)	16.28	(16.29)	(16.79)
LSD (P=0.05)	0.308	0.300	0.110	0.120	0.130	0.140	0.212	0.226	0.245	0.264	0.226	0.236
Weed management												
Weedy check	6.59	6.60	2.74	2.83	3.12	3.20	4.59	4.44	5.61	5.13	4.44	4.52
	(51.88)	(51.93)	(8.11)	(8.75)	(10.71)	(11.39)	(24.52)	(22.87)	(37.19)	(30.90)	(22.89)	(23.84)
Hand weeding at 30 DAS	4.11	4.04	1.74	1.83	1.49	1.75	3.33	3.66	3.99	4.18	2.83	3.02
	(19.77)	(18.91)	(2.81)	(3.16)	(1.90)	(2.83)	(12.39)	(15.28)	(18.22)	(20.25)	(8.69)	(10.00)
Alachlor 2.0 kg/ha	4.06	4.00	2.14	2.11	1.64	1.78	3.88	3.79	2.40	2.53	3.46	3.37
	(18.91)	(18.30)	(4.60)	(4.46)	(2.43)	(2.97)	(17.25)	(16.53)	(6.11)	(6.91)	(13.50)	(12.64)
Alachlor 1.5 kg/ha + HW	2.74	2.62	1.29	1.25	1.42	1.45	1.82	2.02	1.18	1.88	2.54	2.68
at 40 DAS	(8.34)	(7.59)	(1.27)	(1.14)	(1.66)	(1.73)	(3.22)	(4.23)	(0.98)	(3.49)	(6.84)	(7.69)
LSD (P=0.05)	0.201	0.199	0.082	0.084	0.081	0.860	0.157	0.155	0.159	0.150	0.146	0.148

*Original values are given in parentheses

competitive effect against weeds either in time or space than monocropping (Srikrishnah *et al.* 2008). Makindea *et al*. (2009) also found that the leafy greens can be intercropped with maize to control weeds and increase productivity.

Weed control efficiency

Weed control efficiency at 75 DAS for blackgram was the highest under alachlor 1.5 kg/ha + HW at 40 DAS (91 - 92%) which was followed by HW at 30 DAS (75 - 76%) and alachlor 2.0 kg/ha (69%) (Table 3). Weed control efficiency at harvest of maize was significantly influenced by weed management, where all the weed management treatments resulted in increase of weed control efficiency over the weedy check. The highest weed control efficiency was observed under alachlor 1.5 kg/ha + HW at 40 DAS (83%) which was followed by alachlor 2.0 kg/ha (59%) and HW at 30 DAS (59-53%). Weed control efficiency of maize was appreciably influenced by planting geometry at harvest of maize (Table 3). The highest weed control efficiency was obtained under maize + blackgram (1:1) which was higher than maize + blackgram (2:2) and maize + blackgram (2:1). This confirmed the findings of Pandey and Prakash (2002).

Grain yield and production efficiency

Grain yield, Productivity rating index (PRI) and Production efficiency (PE) of maize were the highest with maize + blackgram (2:1), followed by maize + blackgram (1:1). However, it was the lowest with maize + blackgram (2:2). All the weed management practices recorded significantly higher values of grain yield, PRI and PE over weedy check. Application of alachlor 1.5 kg/ha + HW at 40 DAS recorded significantly higher values over other weed management practices (Table 3). In case of blackgram, the seed yield, PRI and PE were significantly highest under sole crop and the lowest under maize + blackgram (2:1). All weed management practices recorded significantly higher grain yield, PRI and PE over weedy check. Application of alachlor 1.5 kg/ha + HW at 40 DAS recorded significantly higher values over rest of the weed management practices during first year where it was at par with HW at 30 DAS and alachlor 2.0 kg/ha. Several workers also advocated that the legume and non legume intercropping, yield of non legume increased in intercropping as compared with monocropping (Brintha and Seran, 2008). Mashingaidze (2004) found that by intercropping land was effectively utilized and yield was improved. Intercropping occupies greater land use and thereby provides higher net returns (Seran and Brintha 2009).

It was concluded that planting geometry of maize + blackgram (2:1) was found to be best in terms of maize yield and sole in terms of blackgram yield. Application of alachlor 1.5 kg/ha + HW at 40 DAS resulted in the highest weed control efficiency, grain yield, PRI and PE of maize and blackgram.

Table 3. Grain yield, productivity rating index (PRI) and production efficiency (PE) of maize and blackgram as influenced by planting geometry and weed management in maize + blackgram intercropping system

Treatment	Maize						Blackgram						Maize		Blackgram	
	Grain yield (kg/ha)		PRI		PE		Grain yield (kg/ha)		PRI		PE		Weed Control efficiency			
	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005
Planting Geometry																
Maize sole	2935	2142	146.8	107.1	28.8	20.8	-	-	-	-	-	-	-	-	-	-
Blackgram sole	-	-	-	-	-	-	633	665	211.2	221.9	8.0	8.5	-	-	-	
Maize + blackgram (1:1)	3080	2235	154.01	111.8	30.2	21.7	382	453	127.5	151.1	4.8	5.8	32.9	32.4	-	-
Maize + blackgram (2:1)	3143	2311	157.2	115.6	30.8	22.4	190	329	63.4	109.8	2.4	4.2	16.3	12.7	-	-
Maize + blackgram (2:2)	2356	1738	117.8	86.9	23.1	16.9	293	411	97.8	137.2	3.7	5.3	24.3	24.6	-	-
LSD (P=0.05)	163	152	8.15	7.6	1.60	1.5	31.50	43.40	14.7	21.9	0.56	0.84	-	-	-	-
Weed management																
Weedy check	2117	1538	105.9	76.9	20.76	14.9	265	253	88.3	84.50	3.43	3.28				
Hand weeding at 30 DAS	3096	2224	154.8	111.2	30.35	21.6	407	488	135.8	162.7	5.15	6.23	58.93	52.94	75.52	75.82
Alachlor 2.0 kg/ha	2931	2056	146.6	102.8	28.74	19.9	400	516	133.3	172.0	5.11	6.67	59.56	58.70	69.06	68.59
Alachlor 1.5 kg/ha + HW at 40 DAS	3370	2608	168.5	130.4	33.0	25.3	427	602	142.4	200.8	5.3	7.6	85.6	82.7	91.6	90.5
LSD (P=0.05)	70	130	3.49	6.55	0.68	1.27	18.3	28.6	12.69	15.42	0.48	0.59	-	-	-	-

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