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Integrated Weed Management Studies in Maize Based Intercropping System

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ABSTRACT

A field experiment was conducted during **kharif** seasons of 2001 and 2002 at Rajasthan College of Agriculture, Udaipur to study the effect of planting pattern and weed control methods on weeds and productivity of maize and soybean. Intercropping of maize with soybean, irrespective of their row ratio, effectively reduced the weed density and dry weight of weeds at 50 DAS compared to their pure cropping. The grain yield of maize in intercropping with soybean was statistically on par with its yield in pure stand; however, productivity of soybean crop was significantly reduced in intercropping system compared with its sole cropping. Maize-equivalent yield in maize+soybean (2 : 2) planting pattern made remarkable improvement (55.55 q ha^{-1}) compared to remaining planting patterns. Alachlor and pendimethalin integrated with one hoeing at 25 DAS were found superior in reducing population as well as dry matter of weed at 50 DAS. Alachlor+hoeing at 25 DAS gave the highest maize equivalent yield (50.88 q ha^{-1}) which was on par with that obtained with pendimethalin+hoeing (49.09 q ha^{-1}).

INTRODUCTION

Maize (*Zea mays* L.) is an important cereal crop of India and plays pivotal role in agricultural economy both as staple food for larger section of population, raw material for industries and feed for animals. Despite high genetic potential and photosynthesis explorative crop, its average productivity achieved in India is very low (1755 kg ha^{-1}) (Fertilizer Statistics, 1999-2000).

In **kharif** season rainfed maize is usually intercropped with legumes for more effective utilization of resources. At Udaipur, intercropping of rainfed maize with soybean proved more productive and remunerative than traditional intercropping of greengram or blackgram with maize (Jat, 1996). Growing of intercrops in widely spaced row not only reduces intensity of weeds but also gives additional yield (Prasad and Rafey, 1996). In traditional agriculture, soybean is generally grown as mixed crop or few lines of intercrop between rows of maize crop. This system of growing soybean and maize together is less effective for yield of both the crops owing to improper spatial arrangement. This limitation can be overcome by adopting appropriate planning patterns (Marshall and Willey, 1983).

Recommendations on application of herbicides for sole crop situations are available but information on use of herbicides under maize+soybean intercropping system predominant in the rainfed areas of south Rajasthan is lacking. Keeping the above facts in view, the present investigation was carried out to see the efficacy of planting patterns on weed control and to evaluate effective weed control method.

MATERIALS AND METHODS

The field experiment was conducted during **kharif** seasons of 2001 and 2002 at Rajasthan College of Agriculture, Udaipur. The region falls under agro-climatic zone IV-A (Sub-Humid Southern Plain and Aravalli Hills) of Rajasthan. Soil of experimental site is clay loam in texture and alkaline in reaction pH 8.1. The soil was medium in available nitrogen (276.85 kg ha^{-1}) and phosphorus (18.99 kg ha^{-1}) and high in available potassium (365.54 kg ha^{-1}).

A set of 24 treatment combinations comprising four planting patterns and six weed management

Table 1. Effect of planting pattern and weed management on density and dry matter of weeds at 50 days after sowing (Mean of two seasons)

Treatment	Weed density (No. m^{-2})			Weed dry weight (g m^{-2})		
	Monocot	Dicot	Total	Monocot	Dicot	Total
Planting pattern						
Maize sole	9.18	4.43	13.61	47.73	13.79	61.52
	(100)	(22)	(216)			
Soybean sole	7.14	3.41	10.54	34.25	9.55	43.81
	(59)	(12)	(128)			
Maize+Soybean (1 : 1)	7.82	3.75	11.56	40.14	10.97	51.12
	(74)	(16)	(160)			
Maize+Soybean (2 : 2)	7.03	3.28	10.31	33.54	9.36	42.91
	(58)	(11)	(123)			
LSD	0.36	0.14	0.48	1.81	0.50	2.17
Weed management						
Weedy	15.11	6.24	21.35	102.60	21.63	124.23
	(261)	(39)	(463)			
Hoeing 25 DAS	6.33	2.72	9.05	25.16	8.29	33.45
	(41)	(7)	(84)			
Alachlor 1.5 kg ha^{-1}	6.66	4.64	11.29	28.06	12.66	40.72
	(44)	(21)	(130)			
Pendimethalin 1.0 kg ha^{-1}	7.86	3.74	11.60	40.80	9.34	50.14
	(62)	(13)	(137)			
Alachlor alongwith hoeing 25 DAS	5.03	2.61	7.64	15.58	7.18	22.76
	(26)	(6)	(60)			
Pendimethalin alongwith hoeing 25 DAS	5.76	2.35	8.11	21.31	6.42	27.73
	(33)	(5)	(67)			
LSD	0.44	0.17	0.58	2.21	0.61	2.65

Original values in parentheses were transformed to $\sqrt{X+0.5}$.

practices was laid out in randomized block design with four replications (Table 1). Maize variety Ganga Safed-2 and soybean variety JS-335 were used as main and intercrop, respectively. The maize was sown at 60 cm spacing and soybean at 30 cm spacing under the recommended package of practices on July 2, 2001 and July 4, 2002. The herbicides were sprayed one day after sowing as pre-emergence spray, with the help of knapsack sprayer using 700 litres of water per ha. As per treatment, hoeing was done manually at 25 DAS.

RESULTS AND DISCUSSION

Effect on Weeds

The major weeds in experimental field were *Echinochloa crusgalli* (L.) Beauv, *Echinochloa colonum* (L.) Linn, *Convolvulus arvensis* L., *Cyperus rotundus* L., *Cynodon dactylon* (L.) Pers., *Commelina benghalensis* L., *Trianthema portulacastrum* L., *Digera arvensis* L. and *Portulaca oleracea* L. The annual monocot weeds dominated the weed flora throughout the crop growth season during both the years. Different planting patterns and sole soybean proved significantly superior over sole maize in reducing weed density and dry matter at 50 DAS. Paired planting of maize and soybean (2 : 2) and sole soybean were more effective in controlling weeds than alternate planting of maize+soybean (1 : 1) and sole maize. The minimum density level of weed dry weight was recorded under paired planting of maize+soybean (2 : 2) system (Table 1). Paired

planting of maize+soybean (2 : 2) registered 16.1 and 30.2% reduction in total weed dry matter over alternate planting of maize+soybean (1 : 1) and sole maize system, respectively (Table 1). The maximum weed control efficiency was recorded by paired system of maize+soybean (2 : 2).This may be attributed to relatively less space available for the growth of weeds due to quick coverage of ground and more shading effect. Similar effects due to planting pattern were also reported by Prasad and Rafey (1996) and Deshveer and Singh (2002).

All the weed management practices significantly reduced the density and dry weight of weeds at 50 DAS over weedy check. Among weed management practices, a combination of alachlor alongwith hoeing proved most effective in controlled monocots as well as total weeds. However, dicot weeds were most effectively controlled by pendimethalin alongwith hoeing. Lowest density and dry weight of monocot weeds (5.0 m^{-2} and 15.5 g m^{-2}, respectively) and total weeds (7.6 m^{-2} and 22.8 g m^{-2}, respectively) were recorded with alachlor alongwith hoeing treatments (Table 1), while maximum reduction in dicot weeds number and their dry matter (2.3 m^{-2} and 6.4 g m^{-2}, respectively) were recorded with pendimethalin alongwith hoeing. Monocot weeds were most efficiently controlled by alachlor alongwith hoeing treatment with weed control efficiency of 84.7%, while maximum weed control efficiency for dicot weed was recorded under pendimethalin alongwith hoeing treatment (70.1%). Higher efficiency of alachlor alongwith hoeing might be due to alachlor which inhibits the seed germination by inhibiting GA_3 induced alpha-amylase and protease production in susceptible weed species (Rao, 2000). Further, hoeing at 25 DAS removed the weeds, which emerged during the later stage of crop growth, in addition to the alachlor application.

Effect on Crop

The grain yield of maize in intercropping with soybean was statistically on par with its yield in pure stand (Table 2). However, intercropping of maize with soybean under planting patterns significantly reduced productivity of soybean crop. Intercropping of maize and soybean resulted in significant higher maize equivalent yield as compared to either sole crop (Table 2). The paired planting system recorded

Table 2. Effect of planting pattern and weed management on grain yield of maize, soybean and maize equivalent yield (kg ha^{-1})

Treatment	Maize			Soybean			Maize equivalent grain		
	2001	2002	Pooled	2001	2002	Pooled	2001	2002	Pooled
Planting pattern									
Maize sole	3788	3645	3716	-	-	-	3788	3645	3716
Soybean sole	-	-	-	1435	1333	13848	3331	3162	3247
Maize+Soybean(1 : 1)	3503	3367	3434	760	714	737	5268	5058	5163
Maize+Soybean (2 : 2)	3675	3536	3605	858	803	831	5667	5442	5555
LSD	NS	NS	NS	0.81	0.68	0.52	3.54	3.33	2.41
Weed management	2619	2508	2564	725	700	712	3227	3126	3176
Weedy									
Hoeing 25 DAS	3763	3594	3678	1030	963	996	4615	4409	4512
Alachlor 1.5 kg ha^{-1}	3717	3547	3632	1011	973	992	4548	4392	4470
Pendimethalin 1.0 kg ha^{-1}	3637	3419	33528	995	959	977	4459	4271	4365
Alachlor alongwith hoeing 25 DAS	4156	4036	4096	1207	1085	1146	5219	4957	5088
Pendimethalin alongwith hoeing 25 DAS	4039	3984	4012	1139	1021	1080	5013	4806	4909
LSD	5.13	4.96	3.53	1.15	0.96	0.74	4.33	4.08	2.95

NS–Not Significant.

significantly higher maize equivalent yield over ultimate planting and sole maize system by 7.6 and 49.5%, respectively. This increase in the total grain production in maize+soybean intercropping system obviously was the result of additional yield of soybean as bonus by utilization of inter-row space of maize crop. Besides this period planting system provided more space (90 cm between pairs) and accommodated two rows of soybean, consequently greater vigour and enhanced plant growth of maize and soybean. The results confirm the findings of Prasad and Rafey (1996) and Singh and Singh (2001).

All weed control methods significantly enhanced grain yield of maize, soybean as well as maize equivalent yield. Alachlor and pendimethalin supplemental with one hoeing at 25 DAS were superior in this regard.

The extent of increase in maize equivalent yield by alachlor and pendimethalin integrated with one hoeing was by 60.3 and 54.6%, respectively, over weedy check. Reduced crop-weed competition under alachlor alongwith hoeing and pendimethalin alongwith hoeing during critical phase of crop growth resulted in increase in yield.

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