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Performance of Under Storey Crops with Different Pruning Regimes and Distances from Tree Base in *Albizia procera* Based Agri-Silviculture System

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ABSTRACT

A field experiment was undertaken during 2006-07 and 2007-08 at National Research Centre for Agro-forestry, Jhansi. The split plot design with three replications was used for field trial. The experiment was carried out with three pruning regimes (70% canopy pruning, 50% canopy pruning and control) and five distances (0.5-1 m, 1-2 m, 2-3 m and 3-4 m) from tree base. The grain yields of both understory crops increased with increasing distance from tree base. The 70% pruning produced significantly higher grain and straw yields of both understory crops in both the years over the 50% pruning and control treatments, respectively.

Key words: *Agri-Silviculture System, Grain Yield, Pruning Regimes, Distance from Tree Base, Under Story Crops, Straw Yield.*

INTRODUCTION

In Agro-forestry system, tree and agricultural crops are grown together and they compete with each other for growth resources such as light, water and nutrients. The resources sharing by the components may result in complementary or competitive effects depending upon the nature of the species involved in system, the manner in which they are grown and the climatic factors. The nature and quantum of these effects depends upon age and size of the trees, nature of the tree species, nature of the agricultural crops, availability of water, nutrients and light. In agro-forestry system, management of tree components through proper pruning has become an essential practice for reducing both above and belowground competition with associated crops[7], In tree crop system, canopy pruning alleviate shading effects on crops and appeared as an effective mean of increasing the light permeability to understory crops[8] and pruning also reduces the competitive ability of the trees, which allow the crop to take advantage of the higher nutrient availability under the alley cropping system. Biomass yields and productivity of crops have also been reported higher under pruned trees condition[6]. The agro-forestry research requires a long term commitment in research resources and it is not easy to separate the complex interacting factors involved in the system[1].

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The advantages of agro-forestry cannot be quantified simply in terms of productivity alone, because some of the benefits are due to environmental improvements, which cannot be measured only by a few seasons. Hence, keeping above points in mind, the field experiment was conducted at NRCAF, Jhansi, UP to understand the shading effect of trees on greengram and wheat crop with respect to grain and straw yield.

MATERIALS AND METHODS

A field experiment was undertaken during 2006-07 and 2007-08 at National Research Centre for Agro-forestry, Jhansi, Uttar Pradesh, India. The soil of the experiment field is *parwa* representing inter-mixed black and red soil group of Bundelkhand region, covered under the order of Alfisol[4]. The soil is medium in texture, moisture retention capacity and workability. Before starting the experiment, composite soil samples were taken at two soil depths viz. 0-15 cm and 15-30 cm and was used for physico-chemical analysis. The site of experimental field is situated at $25^0$27` North latitude and $78^0$35` East longitude, 271 meters above mean sea level in the semi-arid tract of central plateau of India. The treatment plots were maintained with two pruning regimes namely 50 and 70 per cent canopy pruning, tree pruning was done in first week of November before *rabi* sowing in both the years. Pruned branches were used as fuel wood, whereas leaves were incorporated in soil as green manure[2]. The observations during experimentation were recorded on different aspects of tree, intercrops, micro-climatic parameters, soil moisture, rooting pattern, weed dynamics, economics and post harvest soil properties under different treatment plots and light interception was measured with the help of Steady State Porometer. The intensity of light was measured at different distances from tree base (0.5, 1.0, 2.0, 3.0 and 4.0 m) just above the canopy of crops at 10 am, 12 noon, 2 pm ad 3 pm. The recorded 4 times data were averaged and used for calculation[3]. The observations for different parameters were recorded at 30, 60, 90 and120 days after sowing (DAS) and at harvest in wheat. The shade length was recorded 30 and 60 DAS and at harvest in case of *kharif* crop while after 30, 60 and 90 DAS, and at harvest in case of *rabi* crop during both the years of experiment. Pods on 10 sample plants per plot were counted and sum was divided by 10 to recorded number of pods/plant. The crops were grown in a greengram-wheat crop sequence in the experiment field. The greengram variety PDM-54 was sown with the help of seed drill at 30 cm apart using 15 kg seed/ha on 11th July 2006 and 13th July 2007, respectively. This greengram variety mature in 65-70 days and yields 8-10 q/ha average seed yield under normal condition. The Fertilizers were applied at time of sowing and no irrigation was performed while plant protection and weeding operations were adopted just to check their menace. Harvesting was done on 24th September during 2006 and 28th September during 2007, respectively. Wheat sowing was done by seed drill at 25 cm apart by using 100 kg seed/ha on 23rd and 17th November during 2006 and 2007, respectively. The fertilizers were applied @ 60 kg N + 60 kg P_2O_5 + 40 kg K_2O/ha at sowing time in deep furrows, besides, 60 kg N/ha was top dressed in standing crop after first irrigation. Total four irrigations were applied to the crop on crown root initiation (21days after sowing), tillering, dough and milking stage. To keep the wheat crop free from weeds, one hand weeding after 20 to 25 days of sowing was done during each year of the study. No plant protection was undertaken in wheat crop during both the experimental year. The crop was harvested by manual labor on 11th and 7th April during 2006 and 2007, respectively.

RESULTS AND DISCUSSION

The data for greengram grain yield (Table 1) revealed that 70% pruning produced

significantly higher grain yield and it was 15.8 and 92.2 per cent higher in first year and 19.6 and 103 per cent higher in second year over the yield received in 50% pruning and control treatments, respectively. Similarly each increase in plant distance from tree base improved grain yield significantly up to 4 m distance. The rates of increase in yield at 1, 2, 3 and 4 m distances over 0.5 m distance were 48.5, 164.4, 191.9 and 241.4 per cent in first year and 51.6, 154.9, 184.8 and 223.9 per cent in second year, respectively. Thus, rate of yield increase was found maximum from 1-2 m distance. Interaction effect showed that at 0.5 and 1 m distances, 70% pruning was found on par with 50% pruning but significantly higher yielder than control. At wider spacing beyond 1m, 70% pruning gave significantly highest grain yield while significantly minimum yield was recorded in control treatment.

The greengram straw yield followed the same pattern of grain yield in different treatments (Table 1). The treatment of 70% pruning produced significantly highest greengram straw yield while minimum was recorded in control treatment. Each increase in distance from tree base showed significant increase in straw yield upto widest of 4 m distance in first year but in second year, yield increase beyond 3 m distance was not found significant. Interaction effect was found significant on straw yield also, which behaved almost in a similar manner to grain yield.

It is visible from Table 2 that grain and straw yields of wheat were significantly influenced by both treatment factors during each year of study. Among pruning regimes, 70% pruning produced significantly highest grain yield of 1744 and 1602 kg/ha which were found 647 kg/ha or 59.0 per cent and 1162 kg/ha or 199.7 per cent more in first year and 564 kg/ha or 54.3 per cent and 1050 kg/ha or 190.2 per cent more in second year than the grain yields in 50% pruning and control treatments, respectively. The control treatment produced significantly minimum grain yield of 582 and 552 kg/ha in two years of experimentation. In case of plant distance from tree base, each increase in distance resulted in significant increase in grain yield up to widest distance of 4 meters during both years. The rate of increase in grain yield from 0.5 m to 1, 2, 3 and 4 m distances was 400 kg/ha or 2.09 times, 786 kg/ha or 3.15 times, 1231 kg/ha or 4.36 times and 1456 kg/ha or 4.98 times in first year and 373 kg/ha or 2.24 times, 815 kg/ha or 3.69 times, 1183 kg/ha or 4.92 times and 1439 kg/ha or 5.76 times, respectively in second year of study. It may be observed from significant interaction effect that at 0.5 m distance, 50% pruning and control remained on par while at other distances, 70% pruning produced significantly highest and control produced significantly lowest grain yield. On the other way, increasing distances could not show significant increase up to 2 m in control and up to 1 m in 50% pruning while in 70% pruning each increase in plant distance increase grain yield significantly up to 4 m distance. However, 70% pruning with 3 or 4 m distances produced significantly highest grain yield in both years[5].

Straw yield followed almost the same pattern of wheat grain yield (table 2). The pruning of 70% canopy produced significantly highest straw yield of 3105 kg/ha on first year and 2863 kg/ha in second year. These figures were found 59.6 and 202.3 per cent higher in first year and 54.8 and 194.8 per cent higher in second year than yields in 50% pruning and control treatments, respectively. The increase in plant distance from 0.5 m to 1, 2, 3 and 4 meter increased straw yield by 1.90, 2.62, 3.36 and 3.69 times in first year and 2.04, 3.09, 3.85 and 4.32 times in second year, respectively. Thus, 4 m distance produced significantly highest and 0.5 m produced significantly lowest straw yield during both years. Interaction effect was also found significant on straw and the pattern was observed almost similar to grain yield.

Table 1: Grain and straw yield (kg/ha) of greengram under different pruning regimes and distances from tree base

Distances from tree base (m)	Pruning regimes							
	2006-07				2007-08			
	70%	50%	Control	Mean	70%	50%	Control	Mean
	Grain yield (kg/ha)							
0.5	95.03	82.21	66.67	81.30	85.81	74.12	56.83	72.25
1.0	141.51	129.04	91.72	120.76	128.82	119.04	80.83	109.56
2.0	271.06	231.90	142.05	215.00	242.13	187.22	123.22	184.19
3.0	302.08	263.33	146.42	237.28	273.22	212.71	131.41	205.78
4.0	363.21	306.07	163.33	277.54	301.53	252.00	148.50	234.01
Mean	234.58	202.51	122.04	186.38	206.30	169.02	108.16	161.16
Factors	Pruning	Dist.	P (D)	D (P)	Pruning.	Dist.	P (D)	D (P)
LSD (5%)	15.92	11.38	22.27	19.71	14.47	10.97	21.10	19.00
Pure crop	-	-	-	428.31	-	-	-	381.72
	Straw yield (kg/ha)							
0.5	199.15	180.81	152.18	177.38	180.07	162.00	129.54	157.20
1.0	283.00	270.87	201.62	251.83	256.58	248.90	176.67	227.38
2.0	511.90	462.82	297.20	423.97	458.89	373.40	257.27	363.19
3.0	542.65	500.07	297.80	446.84	490.67	403.33	263.80	385.93
4.0	615.44	549.81	310.16	491.80	511.45	395.00	281.15	395.87
Mean	430.43	392.88	251.79	358.37	379.53	316.53	221.69	305.92
Factors	Pruning	Dist.	P (D)	D (P)	Pruning.	Dist.	P (D)	D (P)
LSD (5%)	31.57	22.68	44.32	39.28	28.74	21.12	40.99	36.58
Pure crop	-	-	-	631.33	-	-	-	537.49

Table 2: Grain and straw yield (kg/ha) of wheat under different pruning regimes and distances from tree base

Distances from tree base (m)	Pruning regimes							
	2006-07				2007-08			
	70%	50%	Control	Mean	70%	50%	Control	Mean
	Grain yield (kg/ha)							
0.5	556	378	165	366	468	297	142	302
1.0	1282	707	310	766	1143	605	277	675
2.0	1834	1099	522	1152	1791	1054	506	1117
3.0	2438	1520	834	1597	2151	1505	800	1485
4.0	2610	1779	1078	1822	2458	1731	1033	1741
Mean	1744	1097	582	1141	1602	1038	552	1064
Factors	Pruning	Dist.	P (D)	D (P)	Pruning.	Dist.	P (D)	D (P)
LSD (5%)	20.8	22.2	37.8	38.5	22.5	24.7	41.8	42.8
Pure crop	-	-	-	2921	-	-	-	2846
	Straw yield (kg/ha)							
0.5	1212	843	362	806	1021	652	313	662
1.0	2545	1423	621	1530	2265	1241	553	1353
2.0	3335	2042	954	2110	3258	1958	927	2048
3.0	4116	2583	1419	2706	3756	2539	1359	2551
4.0	4315	2835	1779	2976	4016	2856	1704	2859
Mean	3105	1945	1027	2026	2863	1849	971	1894
Factors	Pruning	Dist.	P (D)	D (P)	Pruning.	Dist.	P (D)	D (P)
LSD (5%)	29.9	32.5	57.7	56.3	26.5	30.2	53.2	52.3
Pure crop	-	-	-	5039	-	-	-	4814

CONCLUSION

It is concluded from the experiment results that the grain and straw yields of both understory crops increased significantly in both years with 70% canopy pruning and increasing distance from tree base. Thus, the 70 % pruning of tree canopy may be regarded as the best pruning regime for economical intercropping in well established *Albizia procera* based agro-forestry system where greengram-wheat crop sequence is fallowed.

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