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Growth performance of wheat varieties under different pruning intensities of *Dalbergia sissoo* based Agri-silviculture system

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Abstract

A field experiment was carried out at Dusty Acre Research Farm, Department of Forestry, JNKVV, Jabalpur to assess the growth performance of wheat varieties in 13 year old *Dalbergia sissoo* plantation. Maximum grain yield of wheat was recorded when grown under open condition (27.20 q ha⁻¹). Among different pruning intensities, significantly maximum grain yield was recorded under 75% pruning (24.4 q ha⁻¹) which in turn was significantly superior to 50% pruning (21.27 q ha⁻¹) and 25% pruning (19.47 q ha⁻¹). No pruning recorded significantly lowest grain yield (17.74 q ha⁻¹). The percent reduction in grain yield under no pruning 25%, 50% and 75%. Pruning as compared to open condition was 34.75%, 28.41%, 21.80% and 10.29% respectively. Wheat varieties showed no significant effect on straw yield, however variety Sujata recorded higher straw yield as compared to variety MP 3173 and MP 3288. Different wheat varieties showed significant effect on harvest index. Variety MP 3288 recorded significantly higher harvest index (34.96) followed by MP 3288 (33.90). Variety Sujata recorded lowest harvest index (32.51).

Keywords: Agri-silviculture, Pruning, Pruning intensities, Agroforestry.

Introduction

Majority of Agricultural crops grown with Agroforestry trees and relatively poor yielder due to shade of trees. Shade intensity has strong negative effects on the performance of under storey crops (Singh, 1993) [5]. Light is a critical factor affecting the performance of field crops under Agroforestry intervention. It is the general apprehension of the farmers that trees in association with crops in Agroforestry was compete strongly with crops for nutrients and moisture (Dhyani *et al.*, 1990) [2]. This competition between trees and crops increased with increasing age of tree due to increase in canopy (due to shade). Reduction in yield due to tree shade may be reduced by manipulation in tree canopy which can help to associated crop. There are number of silvicultural operations which can reduce tree canopy, facilitated entry of sunlight, pruning is one of them. Pruning increases the flexibility of agroforestry system, and enables farmers to balances their individuals needs for tree crop products. Pruning provides woody biomass for fire wood, leaf biomass and fodder. In pruning the removal of some part of the tree or crown was obviously reduce the competition ability of tree because crown management was facilitate more light to underneath crops and reduce demand of moisture and nutrients. So, management practices are very necessary to get optimum production from an Agri-silviculture system. Pruning reduced the competitive ability of the trees which allow the crop to take advantage of the higher nutrient availability under the alley cropping system (Hagger *et al.*, 1993) [3]. The research work carried out in past is very scanty and gives very little information on compatibility of crop species varieties and trees, spatial effect of trees on crops.

Material and Method

The Present investigation or Experiment was conducted at Dusty Acre Research Farm, Department of Forestry, Jawaharlal Nehru Krishi Vishwa Vidhyalaya, Jabalpur during Rabi season of 2012 in 13 year old *Dalbergia sissoo* based Agri-silviculture. Jabalpur is situated at 23° 9' North Latitude and 79.58' East longitude at an altitude of 411.78 meters above the mean sea level. It comes under the agroclimatic region classified as Kymore plateau and

Satpura hills and is broadly known as rice-wheat crop zone of Madhya Pradesh. This region has typically arid & semi-arid zone climate with hot dry summer and cold winters.

The mean annual rainfall of Jabalpur is 1350mm mostly received between mid of June to September with occasional rains during winter. The mean monthly temperature goes down to the limit of 4°C during winter, while the maximum temperature reaches as high as 45 °C during summer. Generally relative humidity remains very low during summer (15 to 30%), moderate (60 to 75%) during winter and it attains high value (80 to 95%) during rainy season.

Sujata: The variety “SUJATA” is rainfed wheat evolved from Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M. P.) during the year 1994. The plants is 90 to 100 cm. tall. It is early maturing (120 to 125 days) variety. The earhead are 9 cm. long with long grains having test weight of 30-36 gram. It produces about 20 to 25 quintal grains per hectare. Sujata is rainfed (without providing irrigation but with conservation with moisture) variety. If it is cultivated under better management its yielding ability may be enhanced.

MP 3173: The variety is released by J.N.K.V.V Jabalpur M.P. It's suitable under rainfed as well as irrigated condition and tolerant to drought. It matures in 125 days. Yield potential is 23-25qt/ha-1 in rainfed and 37-40qt/ha-1 in limited irrigation condition. It is non-lodging and non-shattering variety. Grain are lustrous and bold, tolerant to rust. It has ability to sustain irrigation and responsive to fertilizer. Test weight is 40 gm.

MP 3288: Wheat variety MP-3288 developed at JNKVV, Jabalpur. It is semi dwarf, sarbati, bold, and has shining grains with resistance to rust and other diseases, tolerant to heat and drought. It is high yielding, matures in 118-122 days and is suitable for chapatti with good quality attributes.

Pre-harvest observations

To record various observations five places (1 meter row length) in each plot were randomly selected, tagged 15 days after sowing of the crop marked both end by putting wooden sticks.

Plant population

Plant Population per meter row length was recorded 15 days after sowing at three randomly selected spots in each plot. Height of the Plant Height of 5 randomly marked plants were measured in centimeter from the ground level up to the auricle of the upper most fully opened leaf at the stage of crown root initiation (CRI), late tillering (LT), late jointing (LJ), flowering (F), milking (M), dough (D) stage. The mean height was calculated by dividing the summation with five.

Numbers of tillers per meter row length

Total number of tillers per meter row length at all growth stages of the crop (i.e. CRI, LT, LJ, F, M and Dough) and at harvest were recorded by counting from five marked row in each plot and the mean values were calculated.

Grain yield (kg ha⁻¹)

The producer of the net plot was tied in bundles and their weights were recorded by using spring balance. After threshing the grain from each bundle, the weight of clean grain per plot was recorded accurately. The grain yield per hectare was obtained by multiplying the net plot yield by converting factor (10,000 divided by net area (m²) of plot). The yield was expressed in kilograms per hectare.

Straw yield (kg ha⁻¹)

The straw yield of each plot was obtained by subtracting the grain yield from total weight of the bundles per plot. The straw yield per hectare was obtained by multiplying the net plot yield by the converting factor (10,000 dividing by net area (m²) of plot). The yield was expressed in kilograms per hectare.

Harvest Index

Harvest index is expressed as the ratio of economic yield (grain yield) to the total biological yield (grain yield + straw yield) and expressed in percentage. It was calculated as per the formula proposed by Nichiporovich (1967).

$$\text{Harvest Index} = \frac{\text{Economic Yield}}{\text{Biological Yield}} \times 100$$

Result and Discussion

Germination percentage

The germination percentage is one of the most important factors which contribute towards crop growth and ultimately crop yield. The number of seeds germinates/MRL were recorded 15 days after sowing. The data were statistically analysed. The mean germination% per meter row persist under different treatment is given in Table 1.

Table 1: Effect of different pruning intensities of *Dalbergia sissoo* on germination percentage of different varieties of wheat in Agri-silviculture system.

Treatment	Germination percentage (per meter row length)
Pruning Intensities	
P ₀ -No pruning	51.73
P ₂₅ -25% pruning	52.40
P ₅₀ -50% pruning	50.40
P ₇₅ -75% pruning	49.43
Open-No tree	52.40
Wheat Varieties	
V ₁ -Sujata	51.84
V ₂ -MP 3173	51.44
V ₃ - MP 3288	50.60

The data given in Table 1 clearly showed that various treatments viz pruning intensities in *D. sissoo* and wheat varieties did not showed any significant effect on germination percentage per meter row length.

Plant height: The height of plant is an index of growth. The observation on plant height was recorded at crown root initiation (CRI) Late tillers (LT), Late jointing (LJ), flowering (f), Milk (m), dough (D) and at harvest. The data were presented in Table 2.

Table 2: Effect of pruning intensities *D. sissoo* and wheat varieties on plant height (cm) at CRI, LT, LJ, F, M, D stage and at harvest in Agri-silviculture system.

Treatment	Plant height (cm) at different stage of plant growth						At harvest
	CRI	LT	LJ	F	M	D	
Pruning treatment							
P0	15.93	55	85.93	84.33	84.32	84.30	79.87
P25	15.00	56.2	87.93	87.07	86.2	85.27	85.13
P50	16.13	58.4	90.0	90.0	88.4	88.27	87.8
P75	17.00	61.0	90.07	90.07	89.47	88.4	88.27
Open- No tree	17.93	64.4	95.53	94.53	94.47	94.07	93.00
SEm ±	0.24	0.69	0.83	0.81	0.85	0.96	1.1
CD at 0.05	0.72	20.06	2.48	2.43	2.54	2.87	3.2
Wheat varieties							
V1 – Sujata	16.96	60.88	103.76	102.28	100.16	99.12	98.7
V2- MP 3173	16.08	58.6	82.40	85.40	82.40	82.16	82.2
V3 – MP 3288	15.84	57.52	80.52	80.53	80.52	80.16	79.6
SEm ±	0.79	2.81	3.98	4.00	4.06	4.1	2.4
CD at 0.05	NS	NS	11.34	11.4	11.41	11.42	6.8

Data given in Table 2 showed that there was progressive increase in plant height in vegetative phase i.e. from CRI stage to late tillering stage after that growth of plant remain constant in reproductive phase and slight decrease towards maturity due to conversion of manufactured food material from vegetative phase to reproductive phase. Different pruning treatments showed significant effect on plant height in at different critical stages (i.e. CRI, LT, LJ; F,M & dough) and at harvest. In all the stages of plant growth, plant height increased with increasing pruning intensity. Open condition recorded significantly higher plant height 17.93, 64.4, 95.53, 94.47, 94.07cms whereas no pruning recorded significantly lowest plant height (15.93, 55, 85.93, 84.33, 84.32 and 84.3 cm) in all the critical stage, of plant growth i.e. CRI, LT, LJ, F, milk and dough stage, respectively. At harvest open condition recorded significantly taller plant (93 cm) and was

significantly superior to different pruning treatment and no pruning. Among pruning treatments, 75% pruning recorded significantly higher plant height (88.27 cm) closely followed by 50% pruning (87.8 cm) and 25% pruning (85.13 cm) and was significantly superior to no pruning which recorded the lowest plant height (79.87cm).

Variety Sujata recorded significantly taller plant height at late jointing stage (103.76cm) flowering stage (102.28 cm), milk stage (100.16 cm) and dough stage (99.12 cm), whereas variety MP 3288 recorded significantly lowest plant height at all the stages (LT, LJ, F, M and dough stage) at par with MP 3173.

At harvest, variety Sujata recorded significantly taller plant height (98.68 cm) as compared to MP 3173 (82.16cm) and MP 3288 (79.6cm) which were at par.

Table 3: Effect of different pruning intensities of *D. sissoo* and wheat varieties on number of tiller/meter row length at CRI, LT, LJ, F, M and dough stages of plant growth in Agri-silviculture system.

Treatment	Growth stage of plant					
	CRI	Late tillering	Late jointing	Flowering	Milk stage	Dough stage
Pruning treatment						
P0	58.47	68.87	70.87	69.2	69.87	69.47
P25	61.47	71.33	76.73	76.2	76.0	75.93
P50	62.27	73.73	79.07	78.53	78.77	78.73
P75	62.60	75.07	82.00	81.07	80.8	80.07
Open-No tree	66.07	80.13	86.13	85.80	85.63	85.60
SEm±	1.03	1.30	0.86	0.92	0.78	0.81
CD at 0.05	30.07	3.88	2.57	2.75	2.33	2.42
Wheat varieties						
V1-Sujata	61.88	72.20	74.6	73.92	72.96	71.48
V2- MP 3173	62.60	76.68	83.72	83.64	83.12	82.44
V3-MP 3288	62.04	72.60	80.96	79.92	79.20	79.16
SEm±	2.94	3.31	3.47	3.45	2.53	3.39
CD at 0.05	NS	NS	NS	NS	NS	NS

Number of tiller/meter row length-

Number of tiller/meter row length increased from crown root initiation stage to late jointing stage and there after it decreased upto maturity (dough stage). Different pruning intensities showed significant effect on number of tillers/MRL in all the critical stages of plant growth i.e. CRI, LT, LJ, F, m and dough stages. Open condition recorded significantly higher number of tillers per meter row length at CRI (66.07), LT (80.13), LJ (86.13), F (85.8), M (85.63) and dough stage (85.6) and was significantly superior to other pruning treatments and no pruning. In the entire observations 75%

pruning recorded significantly more number of tiller/m row length as compared to other pruning treatments. No pruning recorded significantly lowest number of tiller/meter row length at all the critical stages i.e. CRI (58.47), LT (68.87), LJ (70.87), F (69.2), M (69.87) and dough stages (69.47) of plant growth.

The effect of different wheat varieties on number of tiller/MRL was found not significant in all the critical stages of plant growth however variety MP 3173 recorded more number of tiller/MRL followed by MP 3288 whereas Sujata recorded the lowest number of tillers/MRL.

AT And Post-Harvest Observations

Yield attributing characters

Effective tiller/MRL

Crop under open condition (no tree) recorded significantly higher number of effective tiller/MRL (84.0) at par with 75% pruning (77.4) and 50% pruning (78) and was significantly superior to 25% pruning (75.1) and no pruning (60.3). As the pruning intensities increased, there was significant increase in number of tiller/MRL, hence, 75% pruning recorded

significantly higher number of effective tiller/MRL (78.4) closely followed by 50% pruning (77) and 25% pruning (75.1) but significantly superior to no pruning (60.3) which recorded the lowest number of effective tiller/MRL (Table 4). Different wheat varieties showed significant effect on number of effective tiller/MRL. Variety MP 3173 recorded significantly higher number of effective tiller/MRL (81.9) than variety MP 3288 (72.4) and Sujata (70.6) which were at par.

Table 4: Yield attributing character of wheat as influence of different pruning treatments and wheat varieties under agrihorticulture system of agroforestry.

Treatment	No. of effective tiller/MRL	Length of ear head (cms)	Number of grains/ear head	1000 grain weight (gms)
Pruning treatment				
P0	60.3	7.85	38.53	27.09
P25	75.1	8.5	40.8	32.37
P50	77.0	8.6	41.6	38.16
P75	78.4	8.63	42.8	35.51
Open- No tree	84.0	8.85	45.39	39.55
SEM	3.0	0.1	0.29	0.49
CD at 0.05	8.2	0.3	0.88	1.48
Wheat varieties				
V1-Sujata	70.6	8.4	42.0	37.6
V2-MP 3173	81.9	8.6	43.86	32.91
V3-MP 3288	72.4	8.5	39.8	35.49
SEM	3.5	0.4	0.97	1.18
CD at 0.05	10.9	NS	2.78	3.35

Length of ear head

Significantly maximum ear head length was recorded under open condition (8.85 cm) closely followed by 75% pruning (8.63 cm) and 50% pruning (8.6 cm) but significantly superior to 25% pruning (8.5 cm). Significantly minimum ear head length was recorded under no pruning (7.85).

Different wheat varieties showed no significant effect on length of earhead, however variety MP 3173 recorded longer earhead (8.6cm) and Sujata which recorded the shorter ear head (8.4cm).

Number of grains/ ear head

Open condition recorded significantly more number of grains/earhead (45.30) and was significantly superior to different pruning treatments and no pruning. Among different pruning treatments, 75% pruning recorded significantly more number of grains/earhead (42.8) followed by 50% pruning (41.6) and 25% pruning (40.8). No pruning recorded significantly lowest number of grains/ earhead (38.53).

Variety MP 3173 recorded significantly more number of grains/ ear head at par with Sujata (42.8) but significantly superior to MP 3288 which recorded the lowest 1000 grain weight (39.8) at par with Sujata.

1000 grain weight (test weight)

Pruning intensities showed significant effect on 100 grain weight significantly bolder seeds i.e. 1000 grain weight was recorded in open condition (39.55 gm) closely followed by 75% pruning (39.51 gm) and was superior to other pruning treatments and no pruning. As the pruning intensity increased, 1000 grain weight increased hence 75% pruning recorded significantly higher test weight (39.51gm) closely followed 50% pruning (38.16gm) but significantly superior to 25% pruning (32.57 gm) and no pruning (27.09 gm) which recorded significantly lowest 1000 grain weight.

Variety Sujata gave significantly higher test weight (37.6gm) at par with MP 3288 (35.49 gm) but superior to MP 3173 which recorded the lowest test weight (32.91gm).

Table 5: Grain yield, straw yield and harvest index of wheat as influenced by different pruning intensities and different varieties in Agri-silviculture system.

Treatment	Gran yield (q ha ⁻¹)	Straw yield (q ha ⁻¹)	Harvest Index (%)
Pruning treatment			
P0	17.74	34.53	33.92
P25	19.47	38.46	33.62
P50	21.27	41.54	33.83
P75	24.40	47.78	33.78
Open-No tree	27.20	53.23	33.81
SEM	0.66	4.21	0.11
CD at 0.05	1.99	12.55	NS
Wheat varieties			
V1-Sujata	20.86	43.27	32.51
V2- MP 3173	23.28	43.35	34.96
V3-MP 3288	21.91	42.71	33.90
SEM±	0.73	4.42	0.25
CD at 0.05	2.09	NS	0.72

Grain yield (q ha⁻¹)

Maximum grain yield of wheat was recorded when grown under open condition (27.20 q ha⁻¹). Among different pruning intensities, significantly maximum grain yield was recorded under 75% pruning (24.4 q ha⁻¹) which in turn was significantly superior to 50% pruning (21.27 q ha⁻¹) and 25% pruning (19.47 q ha⁻¹). No pruning recorded significantly lowest grain yield (17.74 q ha⁻¹). The percent reduction in grain yield under no pruning 25%, 50% and 75%. Pruning as compared to open condition was 34.75%, 28.41%, 21.80% and 10.29% respectively. Similar result was also incurred by Newaj *et al.*, (2007) ^[4].

Variety MP-3173 recorded significantly higher grain yield (23.28 q ha⁻¹) at par with MP 3288 (21.91 q ha⁻¹) but significantly, superior to variety Sujata which recorded significantly lowest grain yield (20.86 q ha⁻¹). The percent reduction in grain yield under Sujata, MP 3288 as compared to MP 3173 was 10.3% and 7.6% respectively.

Straw yield (q ha⁻¹)

Open condition recorded significantly higher straw yield (53.23 q ha⁻¹) and was significantly superior to different pruning treatments and no pruning. Among different pruning treatment, 75% pruning recorded maximum straw yield (47.78 q ha⁻¹) which in turn was superior to 50% pruning (41.54 q ha⁻¹) and 25% pruning (38.46 q ha⁻¹) which were at par. No pruning recorded significantly lowest straw yield of 34.53 q ha⁻¹. The percent reduction in straw yield under no pruning, 25% pruning, 50% pruning, 75% pruning over open condition (no tree) was 35.13%, 27.74%, 21.96% and 10.23% respectively.

Wheat varieties showed no significant effect on straw yield, however variety Sujata recorded higher straw yield as compared to variety MP 3173 and MP 3288. Interaction between pruning treatments and varieties was found not significant.

Harvest Index

Different pruning intensities showed no significant effect on harvest index. Different wheat varieties showed significant effect on harvest index. Variety MP 3288 recorded significantly higher harvest index (34.96) followed by MP 3288 (33.90). Variety Sujata recorded lowest harvest index (32.51). A similar result was also given by Couto and Gomes (1995) ^[1] and Newaj *et al.*, (2007) ^[4].

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