J. Soils and Crops 33 (1) 138-142, June 2023 ISSN 0971-2836 (Print)
ISSN 2582-2756 (Online)

PERFORMANCE OF WHEAT (*Triticum aestivum*) CULTIVARS UNDER POPLAR (*Populus deltoides*) BASED AGROFORESTRY SYSTEM

Manish Kumar[1] and Amit Larkin[2]

ABSTRACT

Present investigation was carried out during 2019 under the supervision of College of Forestry, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, to examine the performance of different wheat cultivars. The experiment was laid out in randomized block design with 12 wheat cultivars, *viz.,* VL Gehun 401, VL Gehun 404, VL Gehun 421, VL Gehun 616, VL Gehun 719, VL Gehun 738, VL Gehun 802, VL Gehun 804, VL Gehun 829, VL Gehun 832, VL Gehun 892 and VL Gehun 907. Cultivar VL Gehun 804 was found to have maximum plant height (113.68 cm), number of tillers running^{-1} row meter (132.53), dry weight (126.33 g), number of effective tillers (113.82), flag leaf length (26.87 cm), spike length (14.01 cm) and number of grains spike^{-1} (72.32). Whereas, VL Gehun 802 cultivar was found to have maximum tiller production rate at 60-90 DAS (2.11); VL Gehun 832 cultivar was found to have maximum test weight (40.66 g) and straw yield (54.33 q ha^{-1}). VL Gehun 829 cultivar was found to have significantly maximum grain yield (36.71 q ha^{-1}) and harvest index (41.19) followed by VL Gehun 804 [(grain yield (36.4 q ha^{-1}) and harvest index (40.92)].

(Key words: Agroforestry, wheat cultivars, intercropping, grain yield, significantly)

INTRODUCTION

Rapid demographic change, increasing food demand, timber and NTFPs demand, degradation of natural resources and climate changes making agriculture challenging in India (Kumari *et al.,* 2019; Dhyani and Handa, 2013). Agroforestry play significant contribution to cater the needs of the local population for fuel, fodder, fibre and fruits, most of the Multipurpose Trees (MPTs) are encouraged to grow on the field bunds. In Uttarakhand regions agroforestry have been traditionally established, People are using various agroforestry systems since time immemorial. Agroforestry has been practiced ‘informally’ throughout history, but it was only during the 1970s that it was articulated as a specific ‘formal’ strategy in the struggle to alleviate poverty, secure and sustain rural livelihoods and protect and preserve the environment (Anonymous, 2020). Agroforestry as a system, has the potential to solve many of the environmental and ecological problems associated with increasing pressure on farmland, forests and food security. Intercropping presents the following advantages – protects soils from erosion and maintains soil fertility (Metwally *et al.,* 2018), without the use of inorganic fertilizer; provides natural pest control; diversifies the risks of crop failure and also enhances resilience; and increases the agricultural output (Pinho *et al.,* 2012 and Shah *et al*., 2019). Due to litter fall in winter, poplar become excellent choice for agroforestry systems for cultivation of wheat (*Triticum aestivum* L.) compare to other tree interfaces. Wheat preform good and higher wheat yield reported due to complementary effects on crop (Prakash *et al.,* 2011 and Chauhan 2012). There is a growth in integrating land use systems (Ankushdeep and Kumar, 2022) in farmer’s communities due to early, surly and good economic returns and *Populus deltoides* is one of such suitable tree species for agroforestry systems (Jhariya *et al.,* 2015). The existing permanent inherent promising property of wheat under poplar-based agroforestry system can be achieved by increasing the competitive ability of wheat crop through appropriate and sustainable land use pattern. The main objective of the study was to find out the best suitable wheat cultivar for poplar based agroforestry system.

MATERIALS AND METHODS

The investigation was carried out during the *rabi* season 2019 at the Ramola’s Agriculture Farm, Selaqui, Dehradun, Uttarakhand, India. The experiment was laid out in the Randomize Block Design with three replications. The treatments consisting 12 cultivars - T_1 (VL Gehun 401), T_2 (VL Gehun 404), T_3 (VL Gehun 421), T_4 (VL Gehun 616), T_5 (VL Gehun 719), T_6 (VL Gehun 738), T_7 (VL Gehun 802), T_8 (VL Gehun 804), T_9 (VL Gehun 829), T_{10} (VL Gehun 832), T_{11} (VL Gehun 892) and T_{12} (VL Gehun 907) were allotted randomly. Poplar trees of 3 year age were on bunds of the field with a distance of 4 m. Line sowing of Wheat crop was

1. Asstt. Professor, School of Agriculture and Allied Sciences, Doon Business School, Dehradun- 248001 (Uttarakhand)
2. Assoc. Professor, College of Forestry, SHUATS, Prayagraj- 211007 (Uttar Pradesh)

done in December month in the well ploughed field with 60 kg N ha^{-1}, 40 kg P_2O_5 ha^{-1}, 30 kg K_2O ha^{-1} and 20 kg $ZnSO_4$ ha^{-1} doses of fertilizers. The soil of experimental field was sandy loam in texture and with soil pH 7.6.

The data was recorded for various growth and yield attributes, i.e., plant height and dry weight at 30, 60, 90 and 120 days ; number of tillers running^{-1} row meter at 30, 60 and 90 days ; tiller production rate at 0-30, 30-60 and 60-90 days. Observations on number of effective tillers, flag leaf length, spike length, number of grains spike^{-1}, test weight, grain yield and straw yield were recorded at the harvest. Harvest Index was also calculated by formula.

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

RESULTS AND DISCUSSION

Data regarding performance of different wheat cultivars under poplar based agroforestry condition are given in Table 1 and 1a.

Results indicate that growth and yield of different cultivars of wheat significantly affected. Plant height at 30 DAS (16.83 cm), 60 DAS (38.53 cm), 90 DAS (68.13cm) and 120 DAS (113.68 cm) was found significantly maximum in cultivar VL 804 followed by the cultivar VL Gehun 832 at 30 DAS (16.76 cm) and VL Gehun 719 at 60 DAS (38.13 cm) and VL Gehun 832 at 90 DAS (64.41 cm) and 120 DAS (106.13 cm). Minimum plant height at 30 DAS (9.43 cm), 60 DAS (28.16 cm), 90 DAS (56.12 cm) and 120 DAS (94.71 cm) was recorded in cultivar VL Gehun 404. Maximum number of tillers running^{-1} row meter at 30 DAS (40.46), 60 DAS (83.57) and 90 DAS (132.53) was recorded in VL Gehun 804 followed by VL Gehun 829 at 30 DAS (32.41), at 60 DAS (64.57) and 90 DAS (118.15). Minimum number of tillers running^{-1} row meter at 30 DAS (14.91), 60 DAS (45.91) and 90 DAS (94.91) was recorded in VL Gehun 401.

Maximum tiller production rate at 0-30 DAS (1.42) and 30-60 DAS (1.59) was recorded in VL Gehun 804 and at 60-90 DAS (2.11) maximum tiller production rate was found significantly maximum in VL Gehun 802. VL Gehun 804 (113.82) was found to have maximum number of effective tillers followed by VL Gehun 829 (99.76). Minimum effective tillers were observed in VL Gehun 401 (76.91).

VL Gehun 804 also found to have maximum dry weight at 30 DAS (3.71 g), 60 DAS (23.14 g), 90 DAS (52.98 g) and 120 DAS (126.33 g); flag leaf length (26.87 cm); spike length (14.01 cm) and number of grains spike^{-1} (72.32). Maximum test weight (40.66 g) was recorded in the VL Gehun 832 which was at par with the VL Gehun 804 (40.27 g) and VL Gehun 829 (40.22 g). Minimum test weight was observed in VL Gehun 421 (36.23 g). Maximum straw yield (54.33 q ha^{-1}) was recorded in VL Gehun 832 followed by the VL Gehun 892 (54.31 q ha^{-1}) and minimum straw yield was recorded in VL Gehun 401 (47.99 q ha^{-1}).

VL Gehun 829 was found to produce maximum grain yield (36.71 q ha^{-1}) which was at par with the VL Gehun 804 (36.40 q ha^{-1}), VL Gehun 892 (36.18 q ha^{-1}), VL Gehun 907 (36.12 q ha^{-1}) and VL gehun 832 (35.97 q ha^{-1}) followed by the VL Gehun 802 (32.98 q ha^{-1}). Maximum harvest index (41.19) was recorded in VL Gehun 829 which was at par with the VL Gehun 804 (40.92), VL Gehun 907 (40.09) and VL Gehun 892 (39.98). Minimum gain yield (19.18 q ha^{-1}) and harvest index (27.43) was recorded in VL Gehun 616.

Effect of poplar trees on overall growth and yield observed differently on different cultivars that may be due to different tolerance capacity of different cultivars to competitions for various important resources i.e. moisture, light and nutrients, for growth and yield as same results also reported by Kumar *et al.* (2015) and Arenas *et al.* (2019) where significant reduction in yield was caused due to above and below ground competition for different resources. Kumar *et al.* (2008) also concluded that due to allelopathic effect of trees leads to reduction in growth and yield of agriculture crop. These results are close conformity to Uniyal and Chhetri (2010) research on phytotoxic potential of promising agroforestry tree on agriculture crop, research concluded that potential allelopathy substances leads to stimulatory effect and integrated farming leads competition for light, soil moisture and nutrients. Present results are also close conformity to Craine and Dynzinski (2013), who reported complexity of resources to the competition in space and time and among species.

Based on the performance of wheat cultivars under poplar based agroforestry system for growth and yield attributing parameters in present study, it may be concluded that growth and yield significantly affected by poplar trees. Wheat cultivar VL Gehun 829 (36.71 q ha^{-1}), VL Gehun 804 (36.40 q ha^{-1}), VL Gehun 892 (36.18 q ha^{-1}), VL Gehun 907 (36.12 q ha^{-1}) and VL gehun 832 (35.97 q ha^{-1}) performed well by producing more grain yield than other wheat cultivars. Cultivation of Wheat under agroforestry system could be ecologically viable option for greater productivity and economic security of small farm holders. This system requires information on species compatibility, adaptability, appropriate spatial arrangement of the components and nutrient management practices. Although crops yield decreased in intercropping with poplar but the careful and wise selection of cultivars may reduce the overall financial losses.

Table 1.Performance of wheat cultivars under poplar based agroforestry system

Treatments/ Cultivars	Plant height (cm)				Number of tillers running^{-1} row meter			Tiller production rate (day^{-1})			Number of effective tillers
	30 DAS	60 DAS	90 DAS	120 DAS	30 DAS	60 DAS	90 DAS	(0-30 DAS)	(30-60 DAS)	(60-90 DAS)	
VL Gehun 401	10.84	32.91	60.09	97.85	14.91	45.49	94.91	0.45	0.94	1.67	76.91
VL Gehun 404	9.43	28.16	56.12	94.71	20.54	53.12	108.23	0.69	1.09	1.84	94.52
VL Gehun 421	11.03	34.38	61.77	104.75	27.63	46.38	101.93	0.81	0.61	1.87	85.58
VL Gehun 616	11.82	37.27	62.57	99.82	23.22	63.79	98.71	0.85	1.26	1.14	86.72
VL Gehun 719	15.33	38.13	62.72	97.14	28.89	55.78	111.82	1.12	0.85	1.81	99.21
VL Gehun 738	15.75	35.21	63.92	105.81	26.84	54.15	102.38	0.89	0.79	1.57	85.94
VL Gehun 802	14.52	28.91	59.92	99.94	30.23	55.97	113.68	1.24	0.77	2.11	98.47
VL Gehun 804	16.83	38.53	68.13	113.68	40.46	83.57	132.53	1.42	1.59	1.54	113.82
VL Gehun 829	15.79	30.82	61.56	105.87	32.41	64.73	118.15	1.06	0.81	1.87	99.76
VL Gehun 832	16.76	32.11	64.41	106.13	25.21	55.52	105.14	0.78	1.39	1.42	87.68
VL Gehun 892	14.81	33.49	62.13	102.63	27.17	62.47	102.31	0.85	1.21	1.36	89.85
VL Gehun 907	16.32	34.37	64.12	105.89	32.39	55.31	110.72	1.21	0.69	1.71	94.12
SE(d) ±	**1.69**	**2.15**	**2.69**	**1.91**	**1.65**	**2.49**	**1.86**	**0.07**	**0.1**	**0.12**	**2.07**
CD at 5 %	**3.48**	**4.6**	**5.6**	**3.96**	**3.43**	**4.9**	**3.94**	**0.14**	**0.21**	**0.25**	**4.15**

Table 1 a.Performance of wheat cultivars under poplar based agroforestry system

Treatments / cultivars	Dry weight (g)				Flag leaf length (cm)	Spike length (cm)	Number of grains $spike^{-1}$	Test weight (g)	Grain yield ($q\ ha^{-1}$)	Straw yield ($q\ ha^{-1}$)
	30 DAS	60 DAS	90 DAS	120 DAS						
VL Gehun 401	1.79	12.89	31.34	85.61	19.17	8.02	56.62	36.76	25.41	47.99
VL Gehun 404	2.41	16.41	52.19	116.78	20.83	9.71	60.41	36.87	26.21	50.19
VL Gehun 421	2.41	12.28	50.51	107.67	21.65	9.97	55.69	36.23	25.67	50.47
VL Gehun 616	2.41	19.27	47.12	110.09	20.99	9.51	57.71	37.91	19.18	50.74
VL Gehun 719	2.67	16.08	58	120.11	23.31	9.89	63.29	37.31	30.09	51.07
VL Gehun 738	2.46	15.6	41.93	91.49	22.69	10.87	65.77	37.08	29.77	51.27
VL Gehun 802	2.36	15.09	45.78	104.93	21.51	11.98	66.14	40.14	32.98	52.49
VL Gehun 804	3.71	23.14	52.98	126.33	26.87	14.01	72.32	40.27	36.4	52.55
VL Gehun 829	2.8	17.21	41.07	110.88	22.31	11.98	62.23	40.22	36.71	52.96
VL Gehun 832	2.71	20.21	33.53	102.35	24.57	13.1	67.91	40.66	35.97	54.33
VL Gehun 892	2.61	21.87	29.74	99.57	23.21	13.19	71.87	40.00	36.18	54.31
VL Gehun 907	3.67	18.52	46.61	104.26	22.14	12.59	67.89	40.05	36.12	53.97
SE(d) ±	**0.4**	**0.99**	**0.99**	**1.23**	**1.42**	**0.53**	**4.88**	**0.21**	**0.71**	**0.56**
CD at 5 %	**0.86**	**2.09**	**2.09**	**2.21**	**2.95**	**1.09**	**10.29**	**0.44**	**1.48**	**1.16**

REFERENCES

Ankushdeep and R. Kumar, 2022.Effect of sowing methods and row ratio on agronomic advantages, competition functions and economics of wheat and chickpea intercropping. J. Soils and Crops **32** (1): 59-63.

Anonymous, 2013.Advancing agroforestry on the policy agenda: a guide for decision-makers. In: Place F, Gauthier M(eds) Food and Agriculture Organization of The United Nations, Rome, Italy (Agroforestry Working Paper).

Arenas-Corraliza, M.G., V. Rolo, M.L. López-Díaz and G. Moreno, 2019.Wheat and barley can increase grainWheat and barley can increase grain yield in shade through acclimation of physiological and morphological traits in Mediterranean conditions, Scientific Reports, **9** : Article number: 9547. https://doi.org/10.1038/s41598-019-46027-9

Chauhan, S.K., R. Sharma, S.C. Sharma, N. Gupta and Ritu, 2012. Evaluation of poplar (*Populus deltoids* Bartr. ex Marsh.) boundary plantation based agri-silvicultural system for wheat–paddy yield and carbon storage. Int. J. Agric. For. **2**(5): 239–246.

Craine, J.M. and R. Dybzinski, 2013. Mechanisms of plant competition for nutrients, water and light, Functional ecology, **27**(4): 833-840.https://doi.org/10.1111/1365-2435.12081

Dhyani, S.K. and A.K. Handa, 2013. India needs agroforestry policy urgently: Issues and challenges. Indian J.Agrofor. **15**(2): 1-9.

Jhariya, M.K., S.S. Bargali and R. Abhishek, 2015. Possibilities and Perspectives of Agroforestry in Chhattisgarh, Precious Forests - Precious Earth, Intech Open, DOI: 10.5772/60841.

Kumar, M., B. Mehra, S. Denial and N. Jain, 2015. Effect of plant geometry and number of seedlings per hill on growth, yield and economics of rice under agroforestry system. Annals of Plant and Soil Research, **17** (Special Issue) : 219-221.

Kumar, M., J.J. Lakiang and S. Singh, 2008.Tree–crop interactions in the agroforestry systems of Mizoram. J. Trop. For. Sci.**20**(2) : 91–98. 20.

Kumari, R.,A. Banerjee, R. Kumar, A. Kumar, P. Saikia and M.L. Khan, 2019. Deforestation in India: Consequences and Sustainable Solutions, Forest Degradation Around the World, IntechOpen, DOI: 10.5772/intechopen.85804.

Metwally, A.A. and Y.A.A Hefny, 2018. Influence of some cropping systems and mineral nitrogen fertilizer levels on wheat productivity and its attributes under sandy soil conditions. J.Soils and Crops,**28** (2): 259-264.

Pinho, R.C., R.P. Miller and S.S. Alfaia, 2012. Agroforestry and the Improvement of Soil Fertility: A View from Amazonia. Appl and Environ Soil Sci. https://doi.org/10.1155/2012/616383

Prakash, O., R.P. Dubey, S.K. Dubey and J.S. Deshwal, 2011. Evaluation of ber (*ZizyphusmauritianaLamk*) based agrihorti systems under various tree root management practices on reclaimed Yamuna ravines. Indian J. Soil Conserv.**39**(1): 59–62.

Shah, F. and W. Wu, 2019.Soil and Crop Management Strategies to Ensure Higher Crop Productivity within Sustainable Environments. Sustainability **11**(5) : 1485; doi:10.3390/su11051485.

Uniyal, A.K. and S. Chhetri, 2010. An assessment of phytotoxic potential of promising agroforestry trees on germination and growth pattern of traditional field crops of Sikkim Himalaya, India. Am. Eur. J. Agric. Environ. Sci.**9** (1) : 70–78.

Rec. on 16.10.2022 & Acc. on 21.10.2022