Indian Forester, **151** (8) : 739-744, 2025
DOI: 10.36808/if/2025/v151i8/170561

ISSN: 0019-4816
eISSN: 2321-094X

Growth and Yield of different Blackgram varieties under Bijasal (*Pterocarpus marsupium* Roxb.) based Agrisilviculture System

A field experiment on growth of tree species and yield performances of different blackgram varieties under Bijasal based agrisilviculture system was carried out. The experimental plots were laid out in randomized block design with nine treatments and four replications. The findings indicate that the maximum height increment of Bijasal (Pterocarpus marsupium) was found in T_1:Bijasal+ Black gram (Var. Birsa Urd-1) 52.42 cm followed by T_4:Bijasal+ Black gram (Var. Uttara) 49.97 cm, T_2:Bijasal+ Black gram (Var. Birsa Urd-2) 46.12 cm which was at par with each other whereas the maximum collar diameter increment was found in T_1:Bijasal+ Black gram (Var. Birsa Urd-1) 0.69 cm followed by T_4:Bijasal+ Black gram (Var. Uttara) 0.64 cm, which was at par with each other. The maximum height of black gram was found in T_9: Sole Black gram (Var. Uttara) 63.52 cm and minimum in T_3: Bijasal+ Black gram (Var. WBU-109) 52.75 cm. The grain yield of black gram was found significantly superior in T_6: Sole Black gram (Var. BU-1) 13.76 q ha^{-1} followed by T_9 - Sole Black gram (Var. Uttara) 12.87 q ha^{-1}, T_7 - Sole Black gram (Var. Birsa Urd -2) 12.10 q ha^{-1} which was at par with each other and minimum in T_3: Bijasal + Black gram (Var. WBU-109) 9.9 q ha^{-1}.

Key words: Growth, Yield, Blackgram, Increment, Agrisilviculture

Pterocarpus marsupium based agrisilviculture system is suitable for the farmers of Chota Nagpur Plateau region.

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Received September, 2024
Accepted July, 2025

Introduction

Agroforestry systems are recognized as an integrated approach for sustainable land use aside from their contribution to climate change adaptation and mitigation (Cubbage *et al*., 2013; Nair *et al*., 2009; Schoeneberger *et al*., 2012). Agroforestry is said to have following advantages: protect soils from erosion and maintains soil fertility, without the use of inorganic fertilizer; provide natural pest control; diversify the risks of crop failure and also enhances resilience and to increase the agricultural output and hence also the ability to improve the food security, nutrition, income, health, shelter, social cohesion, energy resources and environmental sustainability.

Pterocarpus marsupium Roxb. (Bijasal.), belongs to family Fabaceae, also known as Vijaysar in India and Indian Kino in foreign countries. It is native to India, Nepal, and Sri Lanka. In India it occurs in parts of the Western Ghats Karnataka- Kerala region and also in the forests of Central India, Gujarat, Odisha and Tamil Nadu. It is used in preparation of many Ayurvedic medicines apart from wooden tumblers for drinking water stored overnight by diabetic patients (Reddy *et al.,* 2008). Blackgram (*Vigna mungo* L.) is important native pulse crop of India and is grown under mono, mixed and multiple cropping systems during rainy (kharif), spring and summer seasons under wide range of agro-climatic conditions. Black gram is also known as mashkalai, blackbean. Blackgram (*Vigna mungo*) is the third important pulse crop in India. It is used as nutritive fodder specially for milch animals. It is also green manure crop. High values of lysine make urd bean an excellent complement to rice in terms of balanced human nutrition Population growth of an annual rate of 1.3%, with 83% of these increases occurring in developing countries has increased the demand for agricultural products and hence increased the pressure on arable lands. *P. marsupium* is

naturally grown timber tree species in this region and also its show good growth performance in plantation of 2m×2m spacing, because of this interest it introduces this species in agrisilviculture system to find out the suitable agriculture intercrop. *P. marsupium* naturally found in this region so farmers are easily to adopted for cultivation of this species on their farm land.

Material and Methods

The *P. marsupium*-based agroforestry system study was conducted at All India Co-ordinated Research filed, near Ranchi Veterinary College, Birsa Agricultural University, Kanke, Ranchi, Jharkhand, India., The study site situated between 23°30' around 651 m from mean sea level. *Pterocarpus marsupium* was planted at spacing of 3×3 m spacing and grow intercrop as four var. of *V. mungo* (Black gram). The experiment design adopted was randomized block design (RBD) with nine treatment and four replications *viz.,* T_1: Bijasal + Black gram (Var. Birsa Urd-1); T_2: Bijasal + Black gram (Var. Birsa Urd-2); T_3: Bijasal + Black gram (Var. WBU-109); T_4: Bijasal + Black gram (Var. Uttara); T_5: Sole Bijasal; T_6: Sole Black gram (Var. Birsa Urd-1); T_7: Sole Black gram (Var. Birsa Urd-2); T_8: Sole Black gram (Var. WBU-109); T_9: Sole Black gram (Var. Uttara).

Observation on tree performance

Initial and final height of all standing trees in each treatment was measured with help of pole method. The height was measured from base to tip of the trees. The collar diameter of all trees was measured and recorded in each treatment with the help of digital caliper. Collar diameter was taken before sowing and at the time of harvesting of agricultural crop. Canopy spread was founded by taking the spread of canopy by the help of measuring scale in both the directions (East-west and North- south).

Observations for agricultural crop

Pre-harvest observations

The day of 50% flowering date was recorded in per plot. For the agricultural crop observation was taken from 10 (ten) randomly selected plants in each treatment and replication. The total height of standing plants, number of primary branches, total pods per plants and 10 pods from each treatment were taken and numbers of seeds present in pod was counted. 1000 seeds grains of each plot were counted and their weight was recorded separately in grams.

Post- harvest observations

Seeds yield per plant (g) : The dried grains (g) of black gram from 10 randomly selected plant was cleaned after threshing and weighed to compute the grain yield.

Seed yield per plot (kg ha^{-1}) : The yield from net plot in kg was recorded after each picking. The data of all picking are consolidated treatment wise and total yield per plot was calculated.

Stover yield (qha^{-1}) : After threshing the grain, the remaining straw and debris was dried under sun and Stover yield was recorded.

Stover yield (kgha^{-1}) **=** Biological yield – Grain yield

Biological yield (qha^{-1}) :It is the sum of seed yield and stover yield.

Biological yield (qha^{-1}) **=** Grain yield + Stover yield

Harvest index (%) : The harvest index (HI) was calculated by using the formula suggested by Singh and Stoskopt (1971).

$$\textbf{Harvest index} = \frac{\text{Grain yield}}{\text{Biological yield}} \times 100$$

Chemical Analysis of soil

Soil samples was collected before sowing and after harvesting of Black gram on depth of 0-15cm. Soil pH was calculated by Digital pH meter (Jackson, 1973); Soil Organic Carbon was estimated by Walkley and Black rapid titration method (1934); Available Nitrogen was estimated Alkaline permanganate method (Subbiah and Asija, 1956); Available Phosphorus was estimated by Bray and Kurtz method (1945); Available Potash was estimated by Ammonium acetate extraction method and flame photometre as described by Jackson (1967).

Result and Discussion

The height (cm), collar diameter (cm) and canopy spread (cm^2) shown in Table 1. The height was maximum found at time of showing and after harvesting in T_1: Bijasal + Black gram (Var. Birsa Urd-1) 72.25 cm and 124.6 cm, respectively followed by T_4: Bijasal + Black gram (Var. Uttara) 69.6 cm and 119.5 cm, respectively which was *at par* to each other and minimum T_5: Sole Bijasal 59.67 cm and 96.57 cm, respectively. The maximum height increment was found in T_1: Bijasal + Black gram (Var. Birsa Urd-1) 52.42 cm followed by T_4: Bijasal + Black gram (Var. Uttara) 49.97 cm, T_2: Bijasal + Black gram (Var. Birsa Urd-2) 46.12 cm which was *at par* with each other and minimum in T_5: Sole Bijasal 36.90 cm. Similarly finding reported by Kombra *et al.* (2023) that the maximum growth increment in plant height and diameter at breast height of eucalypts was recorded under agroforestry than sole Eucalypts (without crop). Sharma *et al.* (2022) observed that maximum growth of forest trees was recorded in agroforestry due to proper availability of nutrients and moisture. The main limiting factor in agroforestry systems is the availability of solar radiation, which together with the competition for water and nutrients limits sugarcane yields in plants near to the forest species in *Eucalyptus grandis* reported by Pinto *et al.* (2005).

The collar diameter was maximum found after 30 DAP and 90 DAP in T_1: Bijasal + Black gram (Var. Birsa Urd-1) 1.63 cm and 2.32 followed by T_4: Bijasal + Black

Table 1 : Height (cm), Collar Diameter (cm) and Canopy Spread (cm) of Bijasal in different combinations of Blackgram varieties under Bijasal based Agrisilviculture system

Treatments	Height (cm)			Collar diameter (cm)			Canopy spread (cm^2)	
	Sowing time	Harvesting time	Increment	Sowing time	Harvesting time	Increment	EW	NS
T_1: Bijasal + Black gram (Var. Birsa Urd-1)	72.25^{a}	124.6^{a}	52.42^{a}	1.63^{a}	2.32^{a}	0.69^{a}	54.65^{a}	55.17^{a}
T_2: Bijasal + Black gram (Var. Birsa Urd-2)	64.55^{bc}	110.6^{bc}	46.12^{ab}	1.41^{ab}	1.96^{bc}	0.54^{b}	47.05^{bc}	50.12^{abc}
T_3: Bijasal + Black gram (Var. WBU-109)	62.57^{bc}	100.0^{c}	37.52^{b}	1.33^{b}	1.85^{c}	0.52^{b}	46.62^{bc}	48.00^{bc}
T_4: Bijasal + Black gram (Var. Uttara)	69.60^{ab}	119.5^{ab}	49.97^{a}	1.52^{ab}	2.16^{ab}	0.64^{a}	52.05^{ab}	53.07^{ab}
T_5: Sole Bijasal	59.67^{c}	96.57^{c}	36.90^{b}	1.07^{c}	1.52^{d}	0.45^{b}	43.02^{c}	46.52^{c}
S.E. $_{(m)\pm}$	2.34	3.91	2.59	0.06	0.07	0.28	1.81	1.59
C.D at $_{(5\%)}$	7.30	12.19	8.07	0.21	0.22	0.08	5.64	4.95
C.V $_{(\%)}$	7.13	7.08	11.58	9.75	7.41	9.98	7.43	6.29

gram (Var. Uttara) 1.52 cm and 2.16 cm which was *at par* to each other and minimum T_5: Sole Bijasal1.07 cm and 1.52 cm, respectively. The maximum collar diameter increment was found in T_1: Bijasal + Black gram (Var. Birsa Urd-1) 0.69 cm followed by T_4: Bijasal + Black gram (Var. Uttara) 0.64 cm, which was *at par* with each other and minimum in T_5: Sole Bijasal 0.45 cm. Similarly finding reported by Kombra *et al.* (2023) that the maximum growth increment in plant height and diameter at breast height of eucalypts was recorded under agroforestry than sole Eucalypts (without crop).

The east to west canopy spread was maximum found in T_1: Bijasal + Black gram (Var. Birsa Urd-1) 54.65 cm followed by T_4: Bijasal + Black gram (Var. Uttara) 52.05 cm which was *at par* to each other and minimum T_5: Sole Bijasal 43.02 cm whereas in north to south direction the maximum canopy spread was found in T_1:Bijasal + Black gram (Var. Birsa Urd-1) 55.17 cm followed by T_4: Bijasal + Black gram (Var. Uttara) 53.07 cm; T_2: Bijasal + Black gram (Var. Birsa Urd-2) 50.12 cm which was *at par* to each other and minimum T_5: Sole Bijasal 46.52 cm.

The yield attributes of Black gram plant height (cm), Days to 50% Flowering, No. of primary branches/ plant, No. of pods/ plants, No. of seeds/pod, Test weight g/ 1000seeds, Seed Yield/plant (gm), Seed Yield (q ha^{-1}), Stover yield (q ha^{-1}), Biological yield (q ha^{-1}) and Harvest index (%)) shown in Table 2. The maximum height of black gram was found in T_9: Sole Black gram (Var. Uttara) 63.52 cm and minimum in T_3; Bijasal+ Black gram (Var. WBU-109) 52.75 cm. The height of green gram varies significantly from each other

The days of 50% flowering of Black gram crop was significantly superior in T_6: Sole Black gram (Var. BU-1) 42.22 followed by T_9: Sole Black gram (Var. Uttara) 41.37, T_7: Sole Black gram (Var. BU-2) 41.35, T_8: Sole Black gram (Var. WBU-109) 40.45 and T_1:Bijasal+ Black gram (Var. Birsa Urd-1) 40.22 which was *at par* with each other and minimum in T_3;Bijasal+ Black gram (Var. WBU-109) 37.85.

Black gram had attained maximum number of branches in T_6: Sole Black gram (Var. Birsa Urd-1) 5.92 followed by T_9 - Sole Black gram (Var. Uttara) 5.70, T_7 - Sole Black gram (Var. Birsa Urd -2) 5.25; T_8 - Sole Black gram (Var. WBU-109) 5.15 which was *at par* to each other and minimum in T_3: Bijasal + Black gram (Var. WBU-109) 4.72.

Number of pods per plant of black gram was maximum found inT_6: Sole Black gram (Var. Birsa Urd-1) 45.05 followed by T_9 - Sole Black gram (Var. Uttara) 42.67, T_7 - Sole Black gram (Var. Birsa Urd -2) 42.37, T_8 - Sole Black gram (Var. WBU-109) 40.42, T_1: Bijasal + Black gram (Var. Birsa Urd-1) 39.40 and T_4:Bijasal + Black gram (Var. Uttara) 39.20 which was *at par* to with each other and minimum in T_3: Bijasal + Black gram (Var. WBU-109) 35.82 found.

The number of seed per pod of black gram (*V. mungo*) crop vary significantly from treatment. The number of seed per pod was found maximum in T_6: Sole Black gram (Var. Birsa Urd-1) 3.65 followed by T_9 - Sole Balack gram (Var. Uttara) 3.47, $_1$:Bijasal + Black gram (Var. Birsa Urd-1) 3.47, T_7 - Sole Black gram (Var. Birsa Urd -2) 3.37, T_4: Bijasal + Black gram (Var. Uttara) 3.25, T_2:Bijasal + Black gram (Var. Birsa Urd-2) 3.20 which was *at par* with each other T_3: Bijasal + Black gram (Var. WBU-109) 3.00.

The Test weight 1000 seeds of Blackgram crop vary from 34.1 gm to 37.8 gm. Similarly, result was reported by Zahoor *et al*. (2021) the maximum number of primary branches, number of pods $plant^{-1}$, pod length, number of seeds pod^{-1} were recorded under sole cropping while their lowest values were observed under agroforestry.

Black gram had attained significantly superior seed yield per plant found in T_6: Sole Black gram (Var. BU-1) 61.57 g and rest of the treatments were significantly inferior and minimum in T_3: Bijasal + Black gram (Var. WBU-109) 36.50 g. The grain yield of black gram crop was found significantly superior in T_6: Sole Black gram (Var. BU-1) 13.76 q ha^{-1}followed by T_9 - Sole Black gram (Var. Uttara) 12.87 q ha^{-1}, T_7 - Sole Black gram (Var. Birsa Urd -2) 12.10 q ha^{-1} which was *at par* with each other and minimum in T_3: Bijasal + Black gram (Var. WBU-109) 9.9 q ha^{-1}.

Table 2 : Yield attributes of different varieties of Blackgram crops under Bijasal based Agrisilviculture system

Treatments	Plant height (cm)	Days to 50% flowering	No. of primary branches/ plant	No. of pods/ plants	No. of seeds/pod	Test weight g/ 1000 seeds	Seed yield/plant (gm)	Seed yield (q ha^{-1})	Stover yield (q ha^{-1})	Biological yield (q ha^{-1})	Harvest index (%)
T_1: Bijasal + Black gram (Var. Birsa Urd-1)	58.62^{ab}	40.22^{abc}	5.05^{bc}	39.40^{ab}	3.47^{ab}	36.2^{ab}	48.40^{bc}	11.62^{bc}	18.62^{abc}	30.25^{bc}	38.56
T_2: Bijasal + Black gram (Var. Birsa Urd-2)	53.72^{b}	38.57^{bc}	4.95^{bc}	36.02^{b}	3.20^{abc}	35.3^{ab}	40.62^{de}	10.50^{c}	16.92^{c}	27.45^{c}	38.45
T_3: Bijasal + Black gram (Var. WBU-109)	52.75^{b}	37.85^{c}	4.72^{c}	35.82^{b}	3.00^{c}	34.1^{b}	36.50^{e}	9.90^{c}	16.80^{c}	26.60^{c}	37.04
T_4: Bijasal + Black gram (Var. Uttara)	56.35^{ab}	38.42^{bc}	5.02^{bc}	39.20^{ab}	3.25^{abc}	35.6^{ab}	44.40^{cd}	11.10^{bc}	18.92^{abc}	30.07^{bc}	37.04
T_5: Sole Bijasal	---	----	----	----	----	----	----	----	----	----	----
T_6: Sole Black gram (Var. Birsa Urd-1)	63.52^{a}	42.22^{a}	5.92^{a}	45.05^{a}	3.65^{a}	37.8^{a}	61.57^{a}	13.76^{a}	22.12^{a}	35.90^{a}	38.46
T_7: Sole Black gram (Var. Birsa Urd-2)	61.25^{a}	41.35^{ab}	5.25^{abc}	42.37^{a}	3.37^{abc}	36.2^{ab}	50.32^{bc}	12.10^{abc}	19.40^{abc}	31.50^{abc}	38.45
T_8: Sole Black gram (Var. WBU-109)	59.95^{ab}	40.45^{abc}	5.15^{abc}	40.42^{ab}	3.10^{bc}	35.6^{ab}	44.42^{cd}	10.80^{bc}	18.45^{bc}	29.27^{bc}	37.03
T_9: Sole Black gram (Var. Uttara)	62.20^{a}	41.37^{ab}	5.70^{ab}	42.67^{a}	3.47^{ab}	36.7^{ab}	53.97^{b}	12.87^{ab}	20.67^{ab}	33.62^{ab}	38.46
S.E. $_{(m)\pm}$	2.27	1.01	0.24	1.87	0.13	1.05	2.03	0.67	1.08	1.75	1.92
C.D at $_{(5\%)}$	6.72	2.99	0.73	5.56	0.40	3.09	6.03	1.99	3.20	5.20	NS
C.V $_{(\%)}$	7.75	5.05	9.52	9.36	8.25	5.85	8.58	11.62	11.40	11.49	10.16

Stover yield of black gram was found significant with treatment and maximum recorded in treatment T_6: Sole Black gram (Var. BU-1) 22.12 q ha^{-1} followed by T_9 - Sole Black gram (Var. Uttara) 20.67 q ha^{-1}, T_7 - Sole Black gram (Var. Birsa Urd -2) 19.40 q ha^{-1}, T_4: Bijasal + Black gram (Var. Uttara) 18.92 q ha^{-1}, T_1: Bijasal + Black gram (Var. Birsa Urd-1) 18.62 q ha^{-1}which was *at par* with each other and minimum in T_3: Bijasal + Black gram (Var. WBU-109) 16.80 q ha^{-1}.The biological yield of black gram was found significantly superior in T_6: Sole Black gram (Var. BU-1)35.90 q ha^{-1}followed by T_9 - Sole Black gram (Var. Uttara) 33.62 q ha^{-1}, T_7 - Sole Black gram (Var. Birsa Urd -2) 31.50 q ha^{-1}which was *at par* with each other minimum inT_3:Bijasal + Black gram (Var. WBU-109) 26.6 q ha^{-1}.

The harvest index was found maximum in treatment T_1: Bijasal + Black gram (Var. Birsa Urd-1) 38.56% and minimum in T_8: Sole Black gram (Var. WBU-109) 37.03%. Similarly, finding reported by Kumar *et al.* (2021) the yield characters of mustard, such as grain yield, straw yield, biological yield and harvest index was maximum in sole Cowpea-Mustard than intercropping.

Soil properties *viz.,* moisture content, pH, organic carbon, available nitrogen, available phosphorus and available potassium at depth of 0-15 cm was shown in Table 3. The maximum soil moisture content was recorded in T_1: Bijasal + Black gram (Var. Birsa Urd-1) 24.45% and minimum in T_5: Sole Bijasal 23.30% whereas after harvest soil moisture was maximum found in T_1: Bijasal + Black gram (Var. Birsa Urd-1) 23.10% and minimum in T_8: Sole Black gram (Var. WBU-109) and T_5: Sole Bijasal 21.85%. Therefore, the result indicate that the moisture content of soil was not much influenced.

The pH of soil before sowing was found significantly superior in T_1: Bijasal + Black gram (Var. Birsa Urd-1) 5.3 and 5.5 and minimum in T_7: Sole Black gram (Var. Birsa Urd-2), T_8: Sole Black gram (Var. WBU-109), T_5: Sole Bijasal 4.7 whereas after harvesting of intercropping maximum pH was found in T_1:Bijasal + Black gram (Var. Birsa Urd-1) 5.5 and minimum in T_5: Sole Bijasal 4.8. The organic carbon content before sowing and after harvesting were maximum found in T_1: Bijasal + Black gram (Var. Birsa Urd-1) 6.1 $gkg^{-1}$and 6.2 gkg^{-1} minimum in T_5: Sole Bijasal 5.6 $gkg^{-1}$and 5.6 gkg^{-1}, respectively. Therefore, after experimentation the organic carbon content of soil was not much influenced.

Similarly, result was reported by Kumar *et al*. (2021) soil OC was increase more in gamhar based agrisilviculture system than in sole tree reported by Muchane *et al*. (2020) reported that SOC and soil pH increased under agroforestry compared to crop monocultures and also concluded that agroforestry can make significant contributions to provision of soil-mediated ecosystem services in the humid and sub-humid tropics.

The available nitrogen, available phosphorus and available potassium of soil before sowing and after harvesting was found more in T_1:Bijasal + Black gram (Var. Birsa Urd-1) 356 kg ha^{-1} and 384 kg ha^{-1}, 11.6 kg ha^{-1} and 15.6 kg ha^{-1}, 207 kg ha^{-1} and 217 kg ha^{-1} minimum in T_5: Sole Bijasal 331 kg $ha^{-1}$and 340 kg ha^{-1}, 9.55 kg ha^{-1} and 11.6 kg ha^{-1}, 184 kg $ha^{-1}$and 192 kg ha^{-1}, respectively. Similarly, result was reported by Kumar *et al*. (2021) the soil OC, available N, P and K increase was more in gamhar based agrisilviculture system than in sole tree. Muchane *et al.* (2020) reported that available N and available P under agroforestry compared to crop monocultures. Kumar *et al.* (2019) reported that available N, P and K in soil at different depths increased significantly under different spacings of Eucalyptus based agroforestry system in all the treatments from its initial values in soil at different depths. Bisht *et al.* (2017) found that agroforestry adds more nutrients to the soil compared to open system.

Table 3: Soil fertility status of 0-15 cm depth under Bijasal based Agrisilviculture system

Treatments	Moisture content (%)		pH		O. C. (g/kg)		Available nutrients (kg ha^{-1})					
							Nitrogen		Phosphorus		Potassium	
	Before sowing	After harvest	Before sowing	After harvest	Before sowing	After harvest	Before sowing	After harvest	Before sowing	After harvest	Before sowing	After harvest
T_1: Bijasal + Black gram (Var. Birsa Urd-1)	24.45^{a}	23.10^{a}	5.3^{a}	5.5^{a}	6.1^{a}	6.2^{a}	356^{a}	384^{a}	11.6^{a}	15.6^{a}	207^{a}	217^{a}
T_2: Bijasal + Black gram (Var. Birsa Urd-2)	24.26^{a}	22.52^{a}	5.0^{abc}	5.2^{abc}	6.0^{a}	6.0^{a}	344^{a}	361^{abc}	11.1^{a}	14.4^{abc}	202^{a}	214^{a}
T_3: Bijasal + Black gram (Var. WBU-109)	24.10^{a}	22.35^{a}	4.9^{abc}	5.2^{abc}	6.0^{a}	6.0^{a}	340^{a}	358^{abc}	10.8^{a}	13.1^{abc}	202^{a}	211^{a}
T_4: Bijasal + Black gram (Var. Uttara)	24.30^{a}	23.05^{a}	5.2^{ab}	5.4^{ab}	6.0^{a}	6.1^{a}	347^{a}	378^{ab}	11.4^{a}	14.5^{ab}	206^{a}	213^{a}
T_5: Sole Bijasal	23.30^{a}	21.85^{a}	4.7^{c}	4.8^{c}	5.6^{a}	5.6^{a}	331^{a}	340^{c}	9.55^{a}	11.6^{c}	184^{a}	192^{a}
T_6: Sole Black gram (Var. Birsa Urd-1)	23.97^{a}	22.20^{a}	4.9^{abc}	5.0^{bc}	6.0^{a}	6.0^{a}	340^{a}	358^{abc}	10.7^{a}	13.0^{abc}	198^{a}	205^{a}
T_7: Sole Black gram (Var. Birsa Urd-2)	23.55^{a}	21.97^{a}	4.7^{c}	5.0^{bc}	5.8^{a}	5.8^{a}	335^{a}	347^{bc}	9.95^{a}	12.2^{bc}	192^{a}	196^{a}
T_8: Sole Black gram (Var. WBU-109)	23.55^{a}	21.85^{a}	4.7^{c}	4.9^{c}	5.7^{a}	5.7^{a}	333^{a}	343^{c}	9.72^{a}	12.0^{bc}	185^{a}	193^{a}
T_9: Sole Black gram (Var. Uttara)	23.80^{a}	22.10^{a}	4.8^{bc}	5.0^{bc}	5.8^{a}	5.8^{a}	338^{a}	350^{bc}	10.3^{a}	12.2^{bc}	193^{a}	202^{a}
S.E. $_{(m)\pm}$	0.90	0.89	0.13	0.12	0.02	0.03	11.38	9.80	0.72	0.83	8.72	10.02
C.D at $_{(5\%)}$	NS	NS	0.38	0.36	NS	NS	NS	28.4	NS	2.45	NS	NS
C.V $_{(\%)}$	7.55	8.02	5.28	4.83	7.37	8.66	6.68	5.47	13.61	12.65	8.87	9.76

Conclusion

Bijasal based agrisilviculture system cultivate the four varieties of Black gram under intercrop with bijasal and sole. During study the maximum height and collar diameter increment was recorded in Bijasal + Urd (Var. Birsa Urd-1). Under agrisilviculture system and sole maximum black gram yield recorded in Birsa Urd-1 varieties. Black gram cultivation under Bijasal based agrisilviculture system indicted improvement in soil nutrients status. Therefore, significant effects were seen on soil pH, available nitrogen and available phosphorus with intercropping and were found in increasing order which is expected to further increase the growth of the system.

बिजासल (*प्टेरोकार्पस मार्सुपियम* रॉक्सब) आधारित कृषि-वनस्पति संवर्धन प्रणाली के अन्तर्गत उड़द की विभिन्न किस्मों की वृद्धि एवं उपज

मिनी भारती, प्रभात रंजन उरांव और बिजय कुमार सिंह

सारांश

बिजासल आधारित कृषि-वनस्पति संवर्धन प्रणाली के अंतर्गत वृक्ष प्रजातियों की वृद्धि एवं उड़द की विभिन्न किस्मों की उपज प्रदर्शन पर एक प्रक्षेत्र प्रयोग किया गया। प्रायोगिक भूखंडों को नौ उपचारों और चार प्रतिकृतियों के साथ यादृच्छिक ब्लॉक डिजाइन में तैयार किया गया था। निष्कर्षों से पता चलता है कि बिजासल (*प्टेरोकार्पस मार्सुपियम*) की अधिकतम ऊंचाई वृद्धि टी$_1$: बिजासल + उड़द (विविधता बिरसा उर्द-1) में 52.42 सेमी पाई गई, उसके बाद टी$_4$: बिजासल + उड़द (विविधता उत्तरा) 49.97 सेमी, टी$_2$: बिजासल + उड़द (विविधता बिरसा उर्द-2) 46.12 सेमी पाई गई, जो एक दूसरे के बराबर थी, जबकि अधिकतम कॉलर व्यास वृद्धि टी$_1$: बिजासल + उड़द (विविधता बिरसा उर्द-1) में 0.69 सेमी पाई गई, उसके बाद टी$_4$: बिजासल + उड़द (विविधता उत्तरा) 0.64 सेमी पाई गई, जो एक दूसरे के बराबर थी। उड़द की अधिकतम ऊँचाई T_9: सोले उड़द (किस्म उत्तरा) में 63.52 सेमी और न्यूनतम T_3: बिजसाल + उड़द (किस्म WBU-109) में 52.75 सेमी पाई गई। उड़द की अनाज उपज T_6: सोले उड़द (किस्म BU-1) 13.76 क्विंटल प्रति हेक्टेयर में काफी बेहतर पाई गई, इसके बाद T_9 - सोले उड़द (किस्म उत्तरा) 12.87 क्विंटल प्रति हेक्टेयर, T_7 - सोले उड़द (किस्म बिरसा उड़द -2) 12.10 क्विंटल प्रति हेक्टेयर थी जो एक दूसरे के बराबर थी और न्यूनतम T_3: बिजसाल + उड़द (किस्म WBU-109) 9.9 क्विंटल प्रति हेक्टेयर थी।

References

Bisht N., Sah V.K., Satyawali K. and Tiwari S. (2017). Comparison of wheat yield and soil properties under open and poplar-based agroforestry system *Journal of Applied and Natural Science*, **9**(3): 1540 -1543.

Bray R.H. and Kurtz L.T. (1945). Determination of total organic and available forms of phosphorous in soil. *Soil Science*, **59**: 36-46.

Cubbage F., Balmelli G., Bussoni A., Noellemeyer E., Pachas A.N., Fassola H., Colcombet L., Rossner B., Frey G., Dube F., de Silva M.L., Stevenson H., Hamilton J. and Hubbard W. (2013). Comparing silvopastoral systems and prospects in eight regions of the world. *Agroforestry Systems*, **86**: 303-314.

Jackson M.L. (1967). *Soil Chemical Analysis*, Prentice-Hall of India, Private, Inc. New Delhi.

Jackson M.L. (1973). *Soil Chemical Analysis*. (Edn.2), Prentice Hall of India Pvt. Ltd., New Delhi.

Kombra S., Ahlawat K.S., Sirohi C., Dalal V., Kumar S., Poonia P., Kumari S. and Yadav S. (2023). Growth, yield and economic analysis of Eucalypts-barley based agroforestry system in semi-arid region of India. *Environment Conservation Journal*, **24**(1): 12-19.

Kumar A., Malik S.M., Oraon R.P., Kumar R., Barla S. and Shabnam S. (2021). Comparative Study of Soil Properties under Gamhar (*Gmelina arborea*) Based Agrisilvicultural System. *International Journal of Plant & Soil Science*, **33**(23): 71-77.

Kumar T., Kumari B., Arya S. and Kaushik P. (2019). Effect of different spacings of *Eucalyptus* based agroforestry systems soil nutrient status and chemical properties in semi-arid ecosystem of India. *Journal of Pharmacognosy and Phytochemistry*, **8**(3): 18-23.

Muchane M.N., Sileshi W.S., Gripenberg S., Jonsson M., Pumariño L. and Barrios E. (2020). Agroforestry boosts soil health in the humid and sub-humid tropics: A meta-analysis. *Elsevier*, **295**: 106899.

Nair P.K.R., Kumar B.M. and Nair V.D. (2009). Agroforestry as a strategy for carbon sequestration. *Journal of Plant Nutrition Soil Science*, **172**: 10-23.

Pinto L.F.G., Bernardes M.S., Stape J.L. and Pereira A.R.

(2005). Growth, yield and system performance simulation of a sugarcane-Eucalyptus interface in a sub-tropical region of Brazil. *Agriculture, ecosystems and environment*, **105**(1-2): 77-86.

Reddy K.N., Pattanaik C., Reddy C.S., Murthy E.N. and Raju V.S. (2008). Plant used in traditional handicraft in north eastern Andhra Pradesh. *Indian Journal of Indian Knowledge*, **7**(1): 162-165.

Schoeneberger M., Bentrup G., Gooijer de H., Soolanayakanahally R., Sauer T., Brandle J., Zhou X. and Current D. (2012). Branching out: agroforestry as a climate change mitigation and adaptation tool for agriculture. *Journal of Soil and Water Conservation*, **67**: 128A–136A.

Sharma A., Sah V.K., Yadav V. and Kaushik P. (2022). Effect of poplar and Eucalyptus-based agroforestry system on soil biochemistry. *Indian Journal of Biochemistry and Biophysics*, **59**(1): 126-130.

Subbiah B.V. and Asija G.L. (1956). A rapid procedure for the estimation of available nitrogen in soil. *Current Science*, **25**: 259-60.

Walkley A. and Black T. A. (1934). An experimentation of the vegetative method for determining organic and proposed modification of the chronic acid titration method. *Soil Sci.,* **37**: 38-39.

Zahoor S., Dutt V., Mughal A.H., Pala N. A., Rashid M., Qaisar K.N. and. Khan P.A. (2021). Economics and productivity of apple-based agroforestry system for livelihood generation in North Western Himalaya, India. *Indian Journal of Agroforestry*, **23**(1): 74-81.