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EFFECT OF PLANTING TECHNIQUES AND SPACING ON DISEASE & INSECT INFESTATION, CORM & CORMEL YIELD OF BUNDA (*COLOCASIA ESCULENTA* VAR. *ESCULENTA*) UNDER BASTAR PLATEAU OF CHHATTISGARH, INDIA

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Abstract

The present investigation was carried out at Research cum Instructional Farm, Shaheed Gundadhoor College of Agriculture and Research Station, experimental field of AICRP on Tuber Crops, Jagdalpur, IGKV, Raipur (C.G.), India, during *Kharif* season 2016. The experiment was laid out in Factorial Randomized Block Design (FRBD) with two factors and three replications. First factor was planting techniques *viz*., A_1- Trench method and A_2- Ridge and furrow method and second factor was spacing *i.e.* B_1- 90 × 30 cm, B_2- 90 × 45 cm, B_3- 75 × 30 cm, B_4- 75 × 45 cm, B_5- 60 × 30 cm and B_6- 60 × 45 cm. The phytophthora blight increased with the advancement in crop age and reached to maximum at 120 DAP. Per centage of phytophthora blight was unaffected by different treatment. Incase of insect (Hairy catterpillar & Aphid) population, it was also remained unaffected by different treatment during experimentation.The length of corm was significantly higher in treatment A_1 (25.17 cm) than the A_2 (9.86 cm) and in spacing treatment B_1 (31.80 cm) was reocrded significantly highest corm length. In case of corm girth, treatment A_1 was produced significanlty maximum corm girth than the A_2. Interaction between planting method × spacing was recorded non significant due to different treatment in com girth and number of corm per plant. Trench method of planting produces significantly maximum length of cormel and weight of corm per plant than the ridge and furrow method. The highest value of corm and cormels yield was produced in planting method *i.e.* trench method than the ridge and furrow method and in case of spacing, 60 × 30 cm was recorded significantly maximum corm and cormels yield of bunda during experimentation. The weight loss percentage was not significantly affected due to different treatments and also their interaction. The highest B: C ratio was obtained in the treatment A_1 than the A_2. In case of interaction between, A × B and $A_1 \times B_5$ was obtained highest B: C ratio and lowest was obtained in $A_2 \times B_2$.

Key words : Bunda, *Colocasia esculenta* var. *esculenta,* planting method, planting spacing, corm and cormel yield, disease & insect.

Introduction

Bunda (*Colocasia esculenta* var. *esculenta* L.) commonly known as *Shakhen* in Chhattisgarh and Bunda in north India. Bunda comes under the family Araceae sub-family aroideae and having chromosome number is 2n=28. Bunda is an important starchy vegetable with high nutritive and medicinal value. In India, it is grown in Uttar Pradesh, West Bengal, Bihar, Chhattisgarh, Jharkhand, Maharashtra, Gujarat and Andhra Pradesh and to a certain extent in Tamil Nadu and Kerala State. In Chhattisgarh State, it is grown in Bastar, Kondagaon, Jagdalpur, Surguja, Korea, Jashpur, Raigarh, Korba, Bilaspur and Balrampur. In Bunda the side tubers are absent and the mother tuber alone swells up to store food material. In the dasheen types of taro, the corm is cylindrical and large. It is up to 30 cm long and 15 cm in diameter, and constitutes the main edible part of the plant. Bunda is widely grown in pacific and Caribbean Islands including Fiji, New Caledonia, New Hebrides, New Guinea and Solomon Islands.

Bunda originated in Inodo-Malayan region of South East Asia and originally cultivated in most of the states in India or Malaysia with diverse genetic resources; where wild forms are still found, which has been confirmed with wide variations in isozyme profiles of Asian taro from India, Indonesia and Japan (Lebot and Aradhya, 1992). Wild forms occur in various parts of South Eastern Asia

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(Purseglove, 1972). Colocasia spread eastwards to other regions with homogeneous equatorial climates from Southeast, Eastern Asia and the Pacific Islands. Archaeological evidence on stone mortars and pestles from the Solomon Islands suggested that colocasia was already in use around 28,000 years ago. The first European navigators observed cultivated colocasia as far as Japan and New Zealand and written records indicate that Captain Cook and his companion noticed colocasia in Maori plantations in 1769 (Matthews, 1995).

Two gene pools appeared with domestication occurring in Southeast Asia and with separation of the land masses of Sunda and Sahul overlapping in Indonesia (Mattews, 1990; Kreike *et al*., 2004). Based on these genepools, Bunda have been designated *Colocasia esculenta* var. *esculenta*, commonly known as dasheen. Dasheen varieties have large central corm, with suckers or stolen, whereas eddoes have a relatively small central corm and a large number of smaller cormels (Purseglove, 1972).

Bunda is one of the starch and carbohydrate rich crop and its leaves and petiole are also used as green vegetables. The crop also has many medicinal properties and is being used in the preparation of ayurvedic medicines. Bunda corms and cormels are also good source of protein minerals like phosphorus and iron. Bunda corm is an excellent source of carbohydrate, the majority being starch of which 17-28% is amylase and the remaining is amylopectin (Oke, 1990). Nutritional content of most of the edible aroids not withstanding their high starch content, edible aroids have a higher content of protein and amino acids than many other tropical root crops (Kay, 1987). Bunda starch is ideal for preparation of baby food and cosmetics. The peeled corms, after -pre cooking and drying can be used to produce a flour, similar to potato flour, which is used for the preparation of soups, biscuits, bread, beverages, infant foods and puddings.

The fresh bunda leaf lamina and petiole contain 80% and 94% moisture, respectively. Humid climate is suitable for this crop and it performs poorly under hot and dry condition. It is best suited in swampy tropical climate with a temperature range of 25°C to 30°C. Annual rainfall about 1000 mm is better for its growth and high yield. For the planting main corm of bunda is cut transversely into pieces in 4 to 5 cm thickness; containing one to two buds and 50 gm is suitable for planting. The top portion of the main corm containing apical bud which is the best for sprouting. The major diseases of colocasia is phytopthora blight, mosaic, tuber rot and insect like aphid and beetle are prominent. In many countries bunda is being replaced by sweet potatoes and cassava largely due to pests and disease problems, which are becoming a limiting factor for bunda production (Ivancic, 1992).

The agronomical practices like, planting technique and spacing are the major factors to achieve maximum yield for any tuber crops. Generally, planting of Bunda is done by ridge and furrow method in some parts of UP, Bihar, Jharkand due to sandy alluvial soil. In the Chhattisgarh State planting of Bunda is done by trench method of planting and farmers getting more corm and cromel yield through this method as compare to ridge and furrow method. Looking to the importance of this crop investigation entitled "Effect of Planting Techniques and Spacing on Disease & Insect, Corm & Cormel Yield of Bunda (*Colocasia esculenta* var. *esculenta*) under Bastar Plateau of Chhattisgarh" conducted in Bastar Plateau of Chhattisgarh.

Materials and Methods

Field experiments were conducted at the Research cum instructional Farm, Shaheed Gundadhoor College of Agriculture and Research Station, AICRP on Tuber crops experimental field, Jagdalpur, IGKV, (C.G.), India; during *Kharif* season (2016). The experiment was laid out in Factorial Randomized Block Design (FRBD) with two factors and three replications. The soil of the experimental site was silty-loam to clay-loam, which is locally known as *Mal* (midland). Field preparation involves ploughing and turning of soil followed by planting by anyone of the methods, *viz*., pit, mounds, trench, ridge and furrow depending on the soil type. Among these methods, 45-60 cm deep trench planting is superior to others due to better tuber growth and yield. Planting spacing 75 × 30 cm and 90 × 45 cm under practice in Chhattisgarh. Bunda is propagated vegetative mostly by corms and cormels weighing 75 g having 2-3 eyes for sprouting. The full dose of FYM 10 tonnes per hectare and vermicompost 1 tonne per hectare has been applied in the prepared field and mix with soil properly. The fertilizer dose 80 kg N, 60 kg P_2O_5 and 80 kg K per hectare applied in the field. The planting of corms and cromels were done after treatment with fungicide. Average sizes of seed corm of bunda were planted at different planting method (Trench and Ridge-Furrow) and different spacing (90 × 30 cm, 90 × 45 cm, 75 × 30 cm, 75 × 45 cm, 60 × 30 cm, 60 × 45 cm) as per treatments. Planting materials were planted on 12th May, 2015.

The half dose of N, full dose of P and K should be applied at the time of planting in trenches and ride and furrows. Remaining half dose of N was applied at 60 days after planting during filling of trenches by soil with

intercultural operation and earthling up. During planting irrigation was applied at 10 days interval up to month of June. Earthling was done at 60 days after planting. Paddy straw was used for mulching was done just after planting of seeds for retaining soil moisture and suppresses weed population in Bunda filed. Observation was recorded from center rows of each plot from randomly selected plants in each treatment and mean values were used for statistical analysis. The data on the different growth and yield characters were collected at 40 days intervals for analysis. Disease Phytophthora blight and insect Hairy caterpillar & Aphids infestation percentage were recorded from different treatment plots. After harvesting the whole corm and cormels are stored in storage house and taken weight of tubers at every 10 day interval and then estimated the weight loss percentage in storage condition and averaged for weekly weight loss percentage. The benefit cost ratio was estimated after calculation of inputs in per hectare for different treatment combination and after harvesting of tubers calculated per hectare yield then B: C ratio was estimated as per values. The data for different characters under study were statistically analyzed to find out the significance of the differences among the treatments.

Results and Discussion

Disease severity (Phytophthora blight) percentage and insect-pest population

Data pertaining to percentage of phytophthora blight of bunda crop at various growth stages are presented in table 1. The phytophthora blight increased with the advancement in crop age and reached to maximum at 120 DAP. Percentage of phytophthora blight was unaffected by different treatment. In case of insect population, it was also remained unaffected by different treatment during experimentation. The maximum phytophthora blight percentage was recorded in the closer spacing. It might be due to more dense population of plants per unit area and more vegetative growth of plant was more suitable for increasing of blight spore.

Length of corm (cm), corm girth (cm) and number of corm plant^{-1}

Data recorded on length of corm, corm girth and number of corm plant^{-1} is presentned in table 2. The data reveals that the length of corm was significantly highest in A_1 than the A_2 and in case of spacing, treatment B_2 was recorded significantly more length of corm which was at par with B_1. The interaction effect of different planting method × spacing was significantly affected in length of corm. The findings revealed that interaction effect of $A_1 \times B_1$ was significantly largest corms and it was at par with $A_1 \times B_2$ and smaller corm was produced by $A_2 \times B_5$. In case of corm girth, A_1 produced significantly maximum corm girth than the A_2. Spacing and interaction between planting method × spacing was found unaffected due to different treatment. In case of number of corms plant^{-1} was recorded non significant effect due to different treatments. The maximum corm length was recorded in wider spacing and trench method of planting. It might be due to more uptakes of plant nutrient from soil depth as well as dense root system and it was grow more vertically. This result has an agreement with results of Hossain (2013) in elephant foot yam. The number of corm plant^{-1} increase with decrease the spacing, it might be due to less availability of nutrients and water to the plant. The result of our finding was similar to Saud *et al*. (2013).

Length of cormels (cm), cormel girth (cm) and number of cormel plant^{-1}

The data reveals that different planting method and spacing could not produce significant effect on length of cormel, cormel girth and number of cormel plant^{-1} during experimentation, except planting method in length of cormel. Treatment A_1 produces significantly maximum length of cormel than the A_2. The maximum corm length was recorded in wider spacing. It might be due to more uptakes of plant nutrient from soil as well as dense root system and it grow more vertically. This result has an agreement with results of Hossain (2013) in elephant foot yam. The maximum number of cormels plant^{-1} was found in wider spacing. It might be due to found highest plant spacing ensured highest vegetative growth and the ultimate results was the highest number of cormels plant^{-1}. This result was also reported by Sikder *et al*. (2014) in Mukhi Kachu. The increase in number of cormels hill^{-1} with the increase of plant spacing was also reported by Ezumah (1973) and Pena (1978).

Total weight of corm and cormel plant^{-1} (kg), weight of corm plant^{-1} (kg) and weight of cormels plant^{-1} (kg)

The data on total corm weight, weight of corm plant^{-1} and weight of cormels are presented in table. The findings revealed that total corm weight and weight of corm plant^{-1} was significantly highest in A_1 than the A_2. Rest of the treatment and interactions were failed to produce significant effect. The maximum corm and cormels weight plant^{-1} was recorded at wider spacing. However, there was a trend of increase in the weight of corm and cormels plant^{-1} with the increase in plant spacing. This increase in the corm and cormels weight plant^{-1} was due to decreasing competition for nutrient, water and light as

Table 1 : Effect of different treatment on percentage (%) of phytophthora blight and insect severity.

Factors	Percentage (%) of phytophthora blight									Insect population (Hairy caterpillar & aphid)		
	40 Days after planting			80 Days after planting			120 Days after planting					
	A_1	A_2	Mean	A_1	A_2	Mean	A_1	A_2	Mean	A_1	A_2	Mean
B_1	27.47	25.95	26.71	36.66	56.62	46.64	45.89	87.62	66.75	201.33	189.73	195.53
B_2	28.55	27.19	27.87	52.33	49.88	51.11	86.00	79.55	82.77	132.60	156.47	144.53
B_3	33.95	29.48	31.72	58.66	50.15	54.41	78.33	86.66	82.50	152.13	121.07	136.60
B_4	26.53	26.66	26.60	58.44	45.42	51.93	79.55	84.99	82.27	168.80	178.73	173.77
B_5	28.97	21.95	25.46	60.01	51.02	55.51	87.00	92.44	89.72	73.13	226.27	149.70
B_6	27.52	28.10	27.81	63.13	54.88	59.01	84.00	84.55	84.28	108.80	142.80	125.80
Mean	28.83	26.56	27.69	54.87	51.33	53.10	76.79	85.97	81.38	139.47	169.18	154.32
Factor	A	B	A ×B	A	B	A ×B	A	B	A ×B	A	B	A × B
SEm±	1.08	1.86	2.64	2.97	5.15	7.29	3.20	5.55	7.85	22.03	38.15	53.95
CD (5%)	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

A_1: Trench Method, A_2: Ridge and Furrow Method; B_1: 90 × 30 cm, B_2: 90 × 45 cm, B_3: 75 × 30 cm, B_4: 75 × 45 cm, B_5: 60 × 30 cm, B_6: 60 × 45 cm, NS : Non significant.

well as shollow soil texture created through trench digging. The increase in corm and cormels weight plant^{-1} with increase in plant spacing was also reported by Atiquzzaman (2007) and Pena (1978).

Yield of corm t/ha and yield of cormels t/ha

Data reveals that yield of corm per hectare was significantly highest in planting method A_1 than the A_2 and in case of spacing, B_5 was recorded significantly highest yield of corm among all the treatments and significantly lowest yield was produced by B2. Interaction was not affected significantly due to different treatments. In case of yield of cormels per hectare, it was affected non significant effect due to different treatments and interaction with planting method with spacing during experimentation. The yield of corms and cormels was increased with the decrease in spacing. However, the closer spacing 60 × 30 cm showed higher yield. It was clearly indicated that the plant population of bunda per unit area determine the total yield of corm per hectare. This finding was agreed with the results to Atiquzzaman (2007) and Bhayan *et al*. (1982).

Total tuber yield (ha)

Data reveals that yield of corms tonnes per hectare was significantly highest in planting method A_1 than the A_2 and in case of spacing, B_5 was recorded significantly highest yield of total tuber among all the treatments and significantly lowest yield was found in by treatment B_2. Interaction was not affected significantly due to different treatments. The total tuber yield was increased with the decrease in spacing. However, the closer spacing 60 × 30 cm shows higher tuber yield. It was clearly indicated that the plant population in bunda per unit area determine the total tuber yield of corm and cormel per hectare. This finding was agreed with the results to Atiquzzaman (2007) and Bhayan *et al*. (1982).

Weight loss during storage (%)

Data presented in table reveals that weight loss in per cent of bunda after harvesting in storage condition of different intervels are not significanlty affected due to different treatments and also interaction between planting method × spacing, was recorded non significantly affect.

Benefit cost ratio

The result pertaining to gross income, net income and benefit cost ratio are presented in table 5. The data shows that the gross income, net income and benefit cost ratio was significantly highest in A_1 than the A_2 and in case of spacing; treatment B_5 was obtained significantly higher gross income, net income and benefit cost ratio among all the spacing treatment. The interaction effect of different planting method × spacing was unaffected in gross income and benefit cost ratio, but the net income was significantly affected. The findings revealed that interaction effect of $A_1 \times B_5$ was significantly higher net income and lowest net income was obtained from $A_2 \times B_2$. The results indicate that higher gross income, net income and benefit cost ratio was obtained in closer spacing. The net income was highest where closer spacing with trench method of planting was used and obtained highest corm and cormel yield t/ha. This result supported by Islam *et al.* (2002) in turmeric crop.

Table 2 : Effect of different treatments on yield attributing characters.

Factors	No. of corm plant^{-1}			Length of cormel (cm)			Cormel girth (cm)			Number of cormels plant^{-1}			Weight of cormels plant^{-1} (kg)			Length of corm (cm)		
	A_1	A_2	Mean	A_1	A_2	Mean	A_1	A_2	Mean	A_1	A_2	Mean	A_1	A_2	Mean	A_1	A_2	Mean
B_1	1.33	1.35	1.34	14.27	7.59	10.93	4.68	6.03	5.36	3.79	4.06	3.92	0.110	0.153	0.132	31.80	9.86	20.83
B_2	1.53	1.40	1.47	16.14	8.62	12.38	5.98	6.79	6.39	5.97	4.57	5.27	0.263	0.130	0.197	28.03	10.81	19.42
B_3	1.36	1.28	1.32	12.62	6.61	9.61	5.04	5.87	5.46	2.98	3.28	3.13	0.093	0.070	0.082	23.77	10.09	16.93
B_4	1.21	1.98	1.60	11.71	6.39	9.05	4.59	6.81	5.70	3.51	3.22	3.37	0.180	0.103	0.142	22.69	9.32	16.01
B_5	1.40	1.32	1.36	12.57	7.84	10.21	6.63	6.44	6.54	3.69	3.68	3.69	0.177	0.097	0.137	21.58	9.28	15.43
B_6	1.29	2.64	1.96	15.58	6.63	11.11	7.89	6.67	7.28	4.37	4.01	4.19	0.197	0.210	0.204	23.18	9.83	16.50
Mean	1.35	1.66	1.51	13.82	7.28	10.55	5.80	6.44	6.12	4.05	3.80	3.93	0.170	0.127	0.149	25.17	9.86	17.52
Factor	A	B	A × B	A	B	A × B	A	B	A × B	A	B	A × B	A	B	A × B	A	B	A × B
SEm±	0.15	0.26	0.37	0.81	1.40	1.98	0.38	0.66	0.94	0.33	0.58	0.81	0.020	0.034	0.048	0.63	1.09	1.55
CD (5%)	N.S.	N.S.	N.S.	2.38	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	1.85	3.21	4.54

A_1: Trench Method, A_2: Ridge and Furrow Method; B_2: 90 × 30 cm, B_2: 90 × 45 cm, B_3: 75 × 30 cm, B_4: 75 × 45 cm, B_5: 60 × 30 cm, B_6: 60 × 45 cm, NS : Non significant.

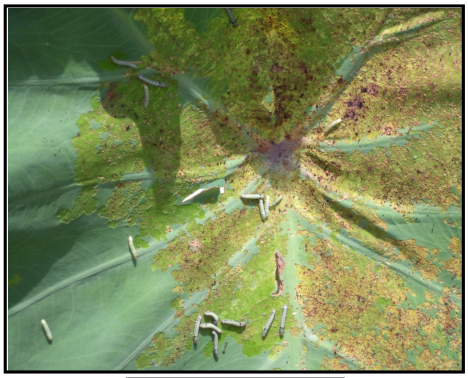
Table 3 : Effect of different treatments on yield attributing characters.

Factors	Corm girth (cm)			Weight of corm plant^{-1} (kg)			Total tuber weight plant^{-1} (kg)			Corm yield tonne^{-1}			Yield of cormel tonne^{-1}			Total Tuber yield tonne^{-1}		
	A_1	A_2	Mean	A_1	A_2	Mean	A_1	A_2	Mean	A_1	A_2	Mean	A_1	A_2	Mean	A_1	A_2	Mean
B_1	15.10	18.36	16.73	0.668	0.352	0.510	0.787	0.48	0.634	24.75	13.05	18.90	4.02	5.51	4.77	28.77	18.56	23.67
B_2	14.73	18.37	16.55	0.594	0.324	0.459	0.855	0.459	0.657	14.67	8.00	11.33	6.46	3.25	4.86	21.13	11.25	16.19
B_3	14.94	17.72	16.33	0.444	0.240	0.342	0.541	0.307	0.424	19.75	10.65	15.20	4.24	3.17	3.70	23.99	13.82	18.9
B_4	16.26	17.89	17.07	0.547	0.339	0.443	0.658	0.406	0.532	16.22	10.05	13.14	5.35	3.03	4.19	21.57	13.08	17.33
B_5	18.99	17.75	18.37	0.659	0.269	0.464	0.805	0.367	0.586	36.59	14.92	25.76	9.83	5.37	7.60	46.42	20.29	33.36
B_6	18.64	19.77	19.21	0.653	0.390	0.522	0.855	0.563	0.709	24.18	14.43	19.31	7.37	7.63	7.50	31.55	22.06	26.81
Mean	16.44	18.31	17.38	0.594	0.319	0.457	0.750	0.430	0.590	22.69	11.85	17.27	6.21	4.66	5.44	28.9	16.51	22.71
Factor	A	B	A × B	A	B	A × B	A	B	A × B	A	B	A × B	A	B	A × B	A	B	A × B
SEm±	0.43	0.75	1.05	0.032	0.055	0.078	0.844	0.076	0.108	1.10	1.91	2.70	0.69	1.19	1.68	1.10	1.91	2.70
CD (5%)	1.27	N.S.	N.S.	0.093	N.S.	N.S.	0.129	N.S.	N.S.	3.23	5.60	N.S.	N.S.	N.S.	N.S.	3.23	5.60	N.S.

A_1: Trench Method, A_2: Ridge and Furrow Method; B_1: 90 × 30 cm, B_2: 90 × 45 cm, B_3: 75 × 30 cm, B_4: 75 × 45 cm, B_5: 60 × 30 cm, B_6: 60 × 45 cm, NS: Non significant.

Phytophthora Blight (*Phytophthora colocasiae*)

Aphid (*Aphis gossypii Glov.*)



Hairy Caterpillar (*Pericallia ricini* Fb.)

Table 4 : Weight loss (%) after harvesting in storage condition.

Factors	10 days after harvesting			20 Days after harvesting			30 days after harvesting		
	A_1	A_2	Mean	A_1	A_2	Mean	A_1	A_2	Mean
B_1	11.02	14.37	12.70	12.88	16.06	14.47	13.85	17.14	15.50
B_2	13.19	11.13	12.16	15.43	12.44	13.94	16.94	13.59	15.27
B_3	11.51	12.24	11.88	13.88	16.75	15.31	15.60	18.32	16.96
B_4	11.58	11.62	11.60	13.65	16.95	15.30	15.30	17.82	16.56
B_5	9.88	9.99	9.93	11.68	11.71	11.69	12.51	12.89	12.70
B_6	9.31	10.78	10.05	10.69	7.11	8.90	11.62	12.67	12.14
Mean	11.08	11.69	11.39	13.03	13.50	13.27	14.30	15.41	14.86
Factor	A	B	A × B	A	B	A × B	A	B	A × B
SEm±	1.03	1.79	2.53	1.34	2.32	3.29	1.31	2.27	3.20
CD (5%)	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

A_1: Trench Method, A_2: Ridge and Furrow Method; B_1: 90 × 30 cm, B_2: 90 × 45 cm, B_3: 75 × 30 cm, B_4: 75 × 45 cm, B_5: 60 × 30 cm, B_6: 60 × 45 cm, NS: Non significant.

Summary and Conclusion

The present study revealed that the treatments were found significant influence on yield and most of the yield contributing characters. The phytophthora blight increased with the advancement in crop age and reached to maximum at 120 DAP. Per centage of phytophthora blight was unaffected by different treatment. Incase of insect (Hairy catterpillar & Aphid) population, it was also remained unaffected by different treatment during experimentation.

The length of corm was significantly highest in A_1 than the A_2 and in case of spacing, treatment B_2 was recorded significantly more length of corm. The interaction effect of different planting method × spacing was significantly affected by length of corm. The findings revealed that interaction effect of $A_1 \times B_1$ was significantly largest corms and smaller corm was produced by $A_2 \times B_5$. In case of corm girth, A_1 produced significantly maximum corm girth than A_2. Interaction between planting method × spacing was found unaffected due to different treatment for length of corms. In case of number of corms per plant was recorded non significant effect due to different treatments. The different planting method and spacing could not produce significant effect on length of cormel, cormel girth and number of cormel per plant during experimentation, except planting method in length of cormel. A_1 found significantly maximum length of cormel than the A_2.

The total corm weight and weight of corm per plant was significantly highest in A_1 than the A_2. Rest at the treatment and interactions are failed to produce significant effect. The yield of corms tonnes per hectare was significantly highest in planting method A_1 than the A_2 and in case of spacing, B_5 was recorded significantly highest yield of corm among all the treatment and significantly lowest yield was produced by B_2. Interaction was not affected significantly due to different treatments. In case of yield of cormels tonne per hectare, it was

Table 5 : Effect of different treatment on gross income, net income and benefit cost ratio.

Factors	Gross income			Net income			Benefit Cost ratio		
	A_1	A_2	Mean	A_1	A_2	Mean	A_1	A_2	Mean
B_1	873000	531000	702000	539642	237276	388459	1.62	0.81	1.21
B_2	596000	339000	467500	203808	19042	111425	0.52	0.06	0.29
B_3	720000	407000	563500	393094	128249	260672	1.20	0.46	0.83
B_4	583000	360000	471500	222168	71402	146785	0.61	0.25	0.43
B_5	1339000	609000	974000	999808	314753	657281	2.95	1.07	2.01
B_6	1068000	623000	845500	704365	326783	515574	1.94	1.10	1.52
Mean	863167	478167	670667	510480	182918	693398	1.47	0.62	1.05
Factor	A	B	A × B	A	B	A × B	A	B	A × B
SEm±	34000	58,889	83282	34000	58889	83282	0.11	0.19	0.26
CD (5%)	100361	173830	N.S.	100361	173830	245833	0.32	0.55	N.S.

A_1: Trench Method, A_2: Ridge and Furrow Method; B_1: 90 × 30 cm, B_2: 90 × 45 cm, B_3: 75 × 30 cm, B_4: 75 × 45 cm, B_5: 60 × 30 cm, B_6: 60 × 45 cm, NS: Non significant.

observed non significant effect due to different treatments and interaction with planting method with spacing during experimentation.

The percent weight loss of bunda tubers during storage after harvesting in storage condition of different intervels are not significanlty affected due to different treatments and also interaction between planting method × spacing, was recorded non significant effect.

The gross income, net income and benefit cost ratio was significantly highest in A_1 than the A_2 and in case of spacing; treatment B_5 was obtained significantly higher gross income, net income and benefit cost ratio. The interaction effect of different planting method × spacing was unaffected by gross income and benefit cost ratio, but the net income was significantly affected. The findings revealed that interaction effect of $A_1 \times B_5$ was significantly higher net income and lowest net income was obtained by $A_2 \times B_2$.

It is concluded that the trench method of planting and planting spacing 60 × 30 cm was given more corm and cormel economic yield as well as more B: C ratio and it may be recommend to farmers of Bastar Plateau for commercial production of Bunda.

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