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Effect of Growing Different Leafy Vegetables as Intercrop on the Yield of Summer Colocasia in Bastar Plateau of Chhattisgarh

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Abstract

An investigation was conducted to study the effect of leafy vegetables as intercrop on the yield of Colocasia planted during the month of December under Bastar Plateau Agroclimatic Zone of Chhattisgarh. The experiment was conducted during Rabi-Summer seasons 2014-15 & 2015-16 at Shaheed Gundadhoor College of Agriculture and Research Station (IGKV) Kumhrawand, Jagdalpur, Bastar (C.G.). The experiment was laid out in Randomized Complete Block Design (RCBD) with seven treatments. The six leafy vegetables tried as inter crops were T_1: Colocasia + Red Amaranthus, T_2: Colocasia + Green Amaranthus, T_3: Colocasia + Spinach, T_4: Colocasia + Fenugreek, T_5: Colocasia + Coriander, T_6: Colocasia + Mustard and T_7: Colocasia alone was planted as contrast. Colocasia variety: Chhattisgarh Arvi-2 was used for the study. The maximum number of cormels per plant (17.84) was recorded in the treatment Colocasia + Mustard, Corm and cormel weight per plant (0.399 kg), Colocasia (33.36 t. ha^{-1}) and per ha was recorded when Colocasia was intercroped with Fenugreek in 1:1 ratio lowest duration of intercrops was for mustard (25.5 days). Maximum intercrop yield was recorded for mustard and the total system yield was for Colocasia+Fenugreek intercropping system. Fenugreek has given highest Benifit Cost Ratio (4.80) followed by spinach and red amaranthus taken in between rows of Colocasia. Intercropping Colocasia + Fenugreek, Colocasia+Spinach and Colocasia + Red Amaranthus in 1:1 ratio may be recommended to farmers for commercial cultivation during Rabi-Summer.

Key words: Colocasia, intercropping, leafy vegetables, total tuber yield, equivalent yield and B:C Ratio.

Introduction

Taro/Arvi (*Colocasia esculenta* var. *antiquorum* (L.) Schott) family: Araceae locally known as Rui, Ghuiya and Konchai in Chhattisgarh. Colocasia is one of the major tropical tuber crops grown in several countries (Chandra, 1984). It is the fourteenth most consumed vegetable worldwide (Lebot and Aradhya, 1991). In Chhattisgarh farmers are cultivating Colocasia in two seasons: during Kharif as rainfed crop and summer as irrigated crop. Summer colocasia is less prone by disease and pest as compared to kharif colocasia and farmers fetches higher price by summer grown crop. Colocasia is the major tuber crop available in the *Badi* or Kitchen garden of the all farmers of Chhattisgarh. Bastar is the district having maximum area and production of Colocasia/Arvi in Kharif season (77.05 ha and 2272.30 tonnes). In Kanwardha district, area of Summer Colocasia is 303.50 ha and production is 5857.55 t under irrigated condition followed by Bastar and Jaspur. Summer colocasia cultivation in Kawardha district is mostly concentrated on the river bank of *Sankri* River. The above mentioned data of area, production and productivity of Colocasia was recorded through conventional survey during the year 2013-2014. All parts of Colocasia (Leaves, Petiole, Corms and Cormels) are used for consumption. Colocasia is rich in starch and its leaves and petioles are also used as green vegetables.

Rabi-Summer planted colocasia takes more time around 30-40, days for sprouting and germination in field after

planting due to effect of temperature. During this period, interspaces of Colocasia may be utilized for production of short duration leafy vegetables like red amaranthus, green amaranthus, spinach, fenugreek, coriander & mustard because, above mentioned leafy vegetables takes only 25-35 days for commercial value. Which leafy vegetable is more competable and high yielding with colocasia main crop and which may be harmful is a researchable issue. Identification of best intercrops and utilization of time, total biomass production per unit area and more income through production of Summer Colocasia/Arvi with leafy vegetable intercrops in Bastar plateau is required for improving livelihood of tribal farmers of Bastar (C.G.). Higher productivity per unit area with intercropping system compared to sole cropping has been reported by many workers (Al-Dalain, 2009; Ijoyah *et al.,* 2012 and Njoku and Muoneke, 2008). Different types of leafy vegetables can be taken as intercrops in the field of Rabi-Summer Colocasia and physiology of these leafy vegetables is different which may be affect the production of Colocasia. So, a study was takenup its need to identify the best leafy vegetable crop to obtain maximum yields from both the crops.

Materials and Methods

Field experiments were conducted at the Research cum instructional Farm, Shaheed Gundadhoor College of Agriculture and Research Station under AICRP on Tuber Crops, Jagdalpur, IGKV, (C.G.) during Rabi-Summer season 2014-15 and 2015-16. The experiment was laid out in Randomized Block Design (RBD) with seven treatments and three replications. The soil of the experimental site was silty-loam to clay-loam, which is locally known as *Mal* (midland). Field preparation was done through ploughing with cultivator, pulverizing with rotavator and leveling with levellor. After field preparation sunken plots 2.5 x 10 m were prepared, applied manures (FYM 10 t. + vermi compost 1 t. ha^{-1}) and fertilizers in small pits and planting was done at a spacing of 50 x 20 cm on Dec. 15th. Sowing of leafy vegetable seeds was done in furrows taken by hand hoe just after the planting of Colocasia in 1:1 ratio. Irrigation was given immidietly after planting of Colocasia and sowing of intercrops like leafy vegetables. The treatments were T_1: Colocasia + red amaranthus, T_2: Colocasia + green amaranthus, T_3: Colocasia + spinach, T_4: Colocasia + fenugreek, T_5: Colocasia + coriander, T_6: Colocasia + mustard and T_7: Colocasia alone. Colocasia variety: Chhattisgarh arvi-2 was used for the study. The fertilizer dose 80 kg N, 60 kg P_2O_5 and 80 kg K per hectare applied in the field. half dose of N, full dose of P and K were applied at the time of planting. Of the nutrients (80:60:80 kg NPK ha^{-1}) and remaining half dose of N was applied at 60 days after planting during intercultural operation and earthling up after complete harvesting of intercrops or leafy vegetables. The data on the different growth and yield characters were collected at 10 days intervals from selected plants in net plots for analysis. The benefit cost ratio (B : C ratio) was also estimated after harvesting of tubers of colocasia and leafy vegetables. Yield of intercrops, equivalent yield and total yield or system yield were also estimated.

Results and Discussion

The data collected from the present investigation are presented in the Table from 1 to 3. There was significant difference in the performance of main as well as intercrops during both the years. The maximum number of cormels per plant 18.35 Nos. was recorded in T_6 during 2014-15 and 17.33 Nos. during 2015-16 when colocasia grown with mustard in 1:1 ratio followed by T_1, Colocasia + Red Amaranthus in 1:1 ratio. The pooled mean for number of cormels per plant recorded was 17.84 in T_6. The highest corm and cormel weight per plant was recorded in T_4 (0.412 kg during 2014-15 and 0.385 kg during 2015-16) in T_4 when Colocasia grown with Fenugreek in 1:1 ratio followed by T_5 and T_3 when Colocasia grown with Coriander and Spinach in 1:1 ratio leafy vegetable intercrops. The total tuber yield of Colocasia was recorded highest (34.36 t.ha^{-1}) with the treatment T_4 when Colocasia was grown with fenugreek in 1:1 ratio followed by T_5 Colocasia + Coriander (32.36 t. ha^{-1}) during the year 2014-15 (Table-1). The total tuber yield of Colocasia during 2015-16 was also recorded highest (32.36 t.ha^{-1}) with the treatment T_4 when Colocasia grown with fenugreek in 1:1 ratio followed by T_3 Colocasia + Spinach and T_1, Colocasia + Red Amaranthus (31.95 t.ha^{-1}). The pooled mean of total tuber yield was recorded highest (33.36 t.ha^{-1}) in T_4 when Colocasia was grown with fenugreek in 1:1 ratio. The treatment T_4, T_3 and T_1 given highest tuber yield of Colocasia when intercrops Fenugreek and Spinach grown in between rows of Colocasia in 1:1 ratio as compare to other intercrops like Red Amaranthus, Green Amaranthus, Coriander and

Mustard as leafy vegetables, which may be due to narrow leaves, slow growth nature and less canopy coverage of Fenugreek and Coriander in the field. The lowest duration (26 days) of intercrops grown between rows of Colocasia in T_6 recroded for Mustard crop and highest duration (48 days) was recorded in T_5 for Coriander crop during the year 2014-15. Average of two years 2014-15 and 2015-16 lowest duration of intercrop (25.5 days) and highest duration (46.50 days) was also recoded for T_6 and T_5 respectively. Mustard is early germinating and is a short duration crop and Coriander is late germinating and a long durtion crop as compared to other intercrops in the experiment. The average of 2014-15 and 2015-16 highest yield of intercrop (6.64 t ha^{-1}) grown between rows of Colocasia was recorded highest in T_6 when Mustard grwon in between rows of Colocasia and lowest yield of intercrop or addition yield (2.24 t ha^{-1}) was recorded for Coriander in T_5. The highest colocasia equivalent yield (3.10 t ha^{-1}) was recoreded in T_3 (Colocasia+ Spinach) and lowest quivalent yield (1.36 t ha^{-1}) in T_2 (Colocasia+ Green Amaranthus) based on the pooled data analysis. The highest equivalent yield through Spinach may be due to higher yield per unit area and yield contributing characters in intecropping system of Maize with different winter vegetables (Hossain et. al., 2015). The highest total yield or system yield (35.30 t.ha^{-1}) was recorded in T_4 when Fenugreek was grown between rows of Colocasia and lowest total yield (29.20 t.ha^{-1}) was recorded in T_7 when Colocasia was grown alone. The highest Benifit Cost Ratio (4.80) was recorded in T_4 when Fenugreek was grown between rows of Colocasia followed by T_3 Colocasia+Spinach (4.51) and T_1 Colocasia + Red Amaranthus (4.42) and lowest B:C Ratio (3.70) was recorded in T_2 when Green Amaranthus was grown in between rows of Colocasia. Fenugreek has given the highest Benifit Cost Ratio as compared to other intercrops, may be due to the higher yield of main crop and intercrop as well as higher price of Fenugreek as leafy vegetable in market. Fenugreek was also observed to be a more compatable intercrop of Colocasia as leafy vegetable followed by Spinach and Red Amaranthus. Many researchers also documented higher gross margin or net return in intercropping system than sole crop under Maize-Vegetable intecropping system (Razzaque et al., 2007; Alom et al., 2008; Bhuiyan et al., 2013; and Farhad et al., 2014; Uddin *et al.* 2009).

Table 1. Yield of main crop and intercrops (2014-15)

Treatments	No. of cormels per plant	Corm and cormel weight per plant (Kg.)	Total tuber yield of Colocasia (t/ ha) Sole crop	Duration of intercops (days)	Yield of intercrops/ additional yield (t/ha)	Colocasia equivalent yield (t/ha)	Total yield (t/ha)	B:C Ratio
T_1: Colocasia+ Red Amaranthus (1:1)	18.13	0.346	28.81	40	4.44	2.96	31.77	4.11
T_2: Colocasia+ Green Amaranthus (1:1)	13.53	0.351	29.22	46	2.67	1.33	30.55	3.77
T_3: Colocasia+Spinach (1:1)	12.87	0.378	31.50	36	5.28	3.16	34.66	4.61
T_4: Colocasia+ Fenugreek (1:1)	13.67	0.412	34.36	41	2.89	1.92	36.28	4.96
T_5: Colocasia+ Coriander (1:1)	15.20	0.392	32.36	48	2.28	2.28	34.64	4.57
T_6: Colocasia+Mustard (1:1)	18.35	0.339	28.22	26	5.56	1.48	29.70	3.99
T_7: Colocasia alone (Check)	15.53	0.329	26.39	-	0.00	0.00	26.39	3.89
CD (at 5 %)	2.427	0.051	2.37	-	-	-	-	-
SEm±	0.779	0.016	1.08	-	-	-	-	-
CV%	8.806	7.810	4.36	-	-	-	-	-

Price of Main crop and intecrops (Rs. per kg.): Red Amaranthus 20/-; Green Amaranthus 15/-; Spinach 18/-; Fenugreek 20/-; Coriander 30/- and Mustard 8/-

Table 2. Yield of main crop and inter crops (2015-16)

Treatments	No. of cormels per plant	Corm and cormel weight per plant (Kg.)	Total tuber yield of Colocasia (t ha^{-1} sole crop	Duration of Intercops (days)	Yield of intercrops/ additional yield (t ha^{-1})	Colocasia equivalent yield (t ha^{-1})	Total yield (t ha^{-1})	B:C Ratio
T1: Colocasia+ Red Amaranthus (1:1)	16.67	0.382	31.95	38	4.16	2.77	34.72	4.72
T2: Colocasia+ Green Amaranthus (1:1)	15.00	0.318	26.49	44	2.78	1.39	27.88	3.63
T3: Colocasia+ Spinach (1:1)	12.67	0.367	30.42	34	5.06	3.04	33.46	4.41
T4: Colocasia+ Fenugreek (1:1)	15.33	0.385	32.36	39	2.92	1.95	34.31	4.64
T5: Colocasia+ Coriander (1:1)	15.67	0.320	26.66	45	2.19	2.19	28.85	3.64
T6: Colocasia+ Mustard (1:1)	17.33	0.373	31.08	25	5.72	1.53	32.61	4.48
T7: Colocasia alone (Check)	14.00	0.372	30.18	-	0.00	0.00	31.00	4.44
CD (at 5 %)	1.718	0.020	1.355	-	-	-	-	-
SEm±	0.552	0.006	0.435	-	-	-	-	-
CV %	6.270	3.055	2.506	-	-	-	-	-

Price of main crop and intecrops (Rs. per kg.): Red Amaranthus 20/-; Green Amaranthus 15/-; spinach 18/-; fenugreek 20/-; coriander 30/- and mustard 8/-

Table 3. Yield of Main crop and inter crops (Pooled mean of 2014-15 & 2015-16)

Treatments	No. of cormels per plant	Corm and cormel weight per plant (Kg.)	Total tuber yield of Colocasia (t ha^{-1}) sole crop	Duration of intercrops (days)	Yield of intercrops/ additional yield (t ha^{-1})	Colocasia equivalent yield (t ha^{-1})	Total yield (t ha^{-1})	B:C Ratio
T1: Colocasia+ Red Amaranthus (1:1)	17.40	0.364	30.38	39	4.30	2.87	33.25	4.42
T2: Colocasia+ Green Amaranthus (1:1)	15.27	0.335	27.855	45	2.73	1.36	29.22	3.70
T3: Colocasia+ Spinach (1:1)	12.77	0.373	30.96	35	5.17	3.10	34.06	4.51
T4: Colocasia+ Fenugreek (1:1)	14.50	0.399	33.36	40	2.91	1.94	35.30	4.80
T5: Colocasia+ Coriander (1:1)	15.44	0.356	29.51	46.5	2.24	2.24	31.75	4.11
T6: Colocasia+ Mustard (1:1)	17.84	0.356	29.65	25.5	5.64	1.51	31.16	4.24
T7: Colocasia alone (Check)	13.77	0.351	29.195	39	0.00	0.00	29.20	4.17
CD (at 5 %)	2.073	0.036	1.863	-	-	-	-	-
SEm±	0.666	0.011	0.758	-	-	-	-	-
CV %	7.538	5.433	3.433	-	-	-	-	-

Price of Main crop and intecrops (Rs. per kg.): Red Amaranthus 20/-; Green Amaranthus 15/-; spinach 18/-; fenugreek 20/-; coriander 30/- and mustard 8/-

Conclusion

Mustard was identified as early maturing intercrop for Colocasia for utilization of space and time. Fenugreek was identified as more compatable intercrop without affacting the yield of Colocasia when grown in between rows of Colocasia as leafy vegetable followed by spinach and red Amaranthus. So, it may be conclud that the fenugreek is the best intercrop of Colocasia in 1:1 ratio followed by fenugreek and red Amaranthus during rabi-summer season for utilization of time and space during early stages before earthing-up of Colocasia crop.

Intercrops: Red Amaranthus, spinach and fenugreek in experimental field

Intercrop: Mustard a short duration leafy vegetable

Colocasia experimental field after harvesting of leafy vegetables/intercrops

Earthing-up of Colocasia experimental field after harvesting of intercrops

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References

Al-Dalain, S. A. 2009. Effect of intercropping of *Zea Maize* with potato (*Solanum tuberosum* L.) on potato growth and on the productivity and land equivalent ratio of potato and zea maize. *Agric. J.,* **4**(3): 164-170.

Alom, M. S., Paul, N. K., Quayyum, M. A. 2008. Performance of hybrid maize (*Zea maize* L.) under intercropping systems with mungbean in different planting methods. *SAARC J. Agri.,* **6**: 73-82.

Bhuiyan, M. S., Bhowal, S. K., Farhad, I. S., Chowdhury, M. M. U., Amin, M. 2013. Intercropping soybean with kaon in varying plant population in the coastal area of Noakhali region, Bangladesh. *Agron. J.,* **16**(1): 81-86.

Chandra, S. 1984. Edible Aroids. *Clearendon Press, Oxford*, pp. 252.

Farhad, I. S. M., Chowdhury, M. M. U., Bhowal, S. K., Choudhury, A. K., Khan, A. S. M. M. R. 2014. Chilli – Garlic Intercropping System In Coastal Saline Area. *App. Sci. Report*. PSCI Publications. **2**(2): 47-50.

Ijoyah, M. O., Bwala. R. I. and Iheadindueme, C. A. 2012. Response of cassava, maize and egusi melon in a three crop intercropping system at Makurdi, Nigeria. *Int. J. Dev. Sustain.,* **1**(2): 135-144.

Lebot, V. and Aradhya, K.M. 1991. Isozyme variation in tato (*Colocasia esculenta* (L.) Schott) from Asia and Oceania. *Euphytica*., **56**: 55-66.

Njoku, D. N. and Muoneke, C. O. 2008. Effect of cowpea planting density on growth, yield and productivity of component crops in cowpea/cassava intercropping system. *J. Trop. Agric. Food Environ. and Ext.,* **7**(2): 106-113.

Razzaque, M. A., Rafiguzzaman, S., Bazzaz, M. M. M., Ali, A., Talukdar, M. M. R. 2007. Study on the intercropping groundnut with chilli at different plant populations. *Bangladesh J. Agril. Res.,* **32** (1): 37-43.

Uddin, M. J., M. A. Quayyum and K. M. Salahuddin. 2009. Intercropping of Hybrid Maize With Short Duration Vegetables at Hill Valleys of Bandarban. *Bangladesh J. Agril. Res.,* **34**(1): 51-57.