EFFECT OF ELEPHANT FOOT YAM + MILLET INTERCROPPING SYSTEMS ON GROWTH, YIELD AND ECONOMICS OF ELEPHANT FOOT YAM [*Amorphophallus paeoniifolious* (Dennst.)Nicolson)].

R. S. Singh[1*], Ashish Narayan[2], Tanweer Alam[3], R. B. Sharma[4], Sunil kumar[1], Amrendra Kumar[5], C.S. Choudhary[6], Ajay Kumar[2], Amalendu Kumar[7], S. S. Prasad[8], I. B. Pandey[9], Veeresh Kumar[10] and Manoj Kumar [11]

1. Associate Professor, 5. Assistant Professor, 9. Professor : Dept. of Agronomy; 2. Associate Professor : Dept. of Genetics & Plant Breeding; 3. Associate Professor : Dept. of Entomology; 6. Associate Professor : Dept. of Plant Pathology; 7. Assistant Professor : Dept. of Agricultural Economics; 10. Senior Technical Officer – Tirhut College of Agriculture; 4. Assistant Professor : Dept. of Plant Pathology – PDDUCHF, Piprakothi; 8. Associate Professor: Dept. of Soil Science,11. Senior Technical Officer - PGCA :: Dr. Rajendra Prasad Central Agricultural University, Pusa (Bihar), India

Email [1*] : dr.ramashankarsingh@gmail.com / rsingh@rpcau.ac.in

ABSTRACT

An experiment on elephant foot yam + millet intercropping systems was conducted at Agricultural Research Farm of Tirhut College of Agriculture, Dholi under Dr Rajendra Prasad Central Agricultural University, Pusa, Samastipur (Bihar), India during 2024-2025 to see the feasibility, profitability and sustainability of growing millets as intercrops in elephant foot yam. It was found that plant height of elephant foot yam under millet intercroppings was increased to the tune of 11.4 to 24.8 per cent while pseudo-stem girth of the elephant foot yam was reduced to the tune of 5.7 to 9.8 per cent as compared to the sole crop of elephant foot yam. Reduction to varying levels in yield of intercrops was also observed to that of their sole crops but equivalent yields of elephant foot yam intercropped with sorghum, finger millet and little millet were found significantly superior than their respective sole crops with the highest value of 36947 kg/ha was estimated under elephant foot yam + sorghum intercropping system. Elephant foot yam equivalent yield, net return and B:C ratio of sole elephant foot yam and all the three intercropping systems of elephant foot yam with sorghum, finger millet and little millet were found comparable.

Keywords **:** Elephant foot yam, millet intercropping, growth, yield, economics.

INTRODUCTION

Elephant Foot Yam [*Amorphophallus paeoniifolious* (Dennst.)Nicolson)] is one of the most important tuber crops of India as well as other parts of the tropical and subtropical world. It is also an important tuber crop grown in Bihar particularly in the districts of northern Bihar. In the present scenario of changing climate, it has

assumed more importance than before due to some unparalleled edges over other crops like- its capacity to produce even in adverse climatic conditions without affecting much on its productivity and its high yield potential (George James and Sunitha, S., 2018). Its farming is also eco-friendly because of less use of agro-chemicals (Singh *et* al., 2019). It has both nutritional and medicinal value and is usually consumed as cooked vegetable. Elephant foot yam is rich in minerals, protein, vitamins-A. (Mukherjee *et* al., 2020).It has high dry matter production capability per unit area than most of the other vegetables. Elephant foot yam is a remunerative and profitable stem tuber crop. The crop is gaining popularity due to its shade tolerance, easiness in cultivation, high productivity, less incidence of pests and diseases, steady demand and reasonably good price. Tubers are mainly used as vegetable after thorough cooking.

Initial slow growth habit of elephant foot yam and its planting at wider spacing makes this crop more suitable to accommodate other short duration crops as intercrops to enhance profitability, resource use efficiency, diversity and sustainability especially under climatic changing scenario. Looking into the growing demand of millets and in the context of 'International Year of Millets 2023' three millets as sorghum (*Sorghum bicolor* L.), finger millet (*Eleusine coracana* L.) and little millet (*Panicum sumatrense*) were taken as intercrops and grown with elephant foot yam in different row ratios. Moreover, millets have the capacity to withstand drought, diseases and pests, stress environments. Millets are rich in essential micronutrient minerals and vitamins especially vitamin B. Keeping these facts in view, this experiment was undertaken.

MATERIALS AND METHODS

The experiment was conducted at Agricultural Research Farm, Dholi of Tirhut College of Agriculture under Dr Rajendra Prasad Central Agricultural University, Pusa (Bihar) during the period of 2024-2025. The soil of the experimental plot was sandy loam with pH value of 8.2. Initial soil analysis value of experimental field was: available nitrogen (168.4 kg/ha), phosphorus (18.09 kg/ha), and potassium (149.7 kg/ha). There were seven treatments comprised of T1-Elephant foot yam (sole crop), T2- Sorghum (sole crop), T3- Finger millet (sole crop) T4- Little millet (sole crop),T5- Elephant foot yam + Sorghum, T6- Elephant foot yam + Finger millet and T7- Elephant foot yam + Little millet. .'Gajendra' was taken as test variety of elephant foot yam with tuber size of 400-500 g. For sorghum, finger millet and little millet, local varieties were taken. Recommended spacing for sole crops were-

90x90cm, 45x15 cm, 20x10 cm and 20x10 cm for elephant foot yam, sorghum, finger millet and little millet, respectively. Elephant foot yam was planted as paired row planting and the spacing between two paired rows was thus 120 cm. In this spacing of 120 cm, millets were sown in additive series. Manures and fertilizers for elephant foot yam was 15 t FYM/ha and 80:60:80 kg N:P:K/ha. For millets manures @ 5.0 t/ha was applied and fertilizer for sorghum was @ 90:45:45 kg/ha and that for finger millet and little millet was 60:30:30 kg N:P:K/ha. Experiment was conducted in Randomized Block Design with three replications. All other standard package of practices were followed in accordance and analysis was done following standard statistical procedures.

RESULTS AND DISCUSSION

On the basis of observations recorded and statistical analysis (Table 1.), it was found that the plant height of elephant foot yam was increased to the tune of 11.4 to 24.8 per cent due to different millet intercropping systems. Highest increase (24.8 %) in plant height was recorded under sorghum intercropping system may be due to more competition for sunlight with sorghum plants than the plants under sole cropping of elephant foot yam. Similar findings were also reported by Singh et al, 2022 in Faba bean intercropping in mustard crop. Lowest increase in plant height of elephant foot yam was estimated in plots of little millet intercropping system may be due to comparatively lower competition for sunlight with little millet plants.

Pseudo-stem girth (cm) on the other hand didn't follow the trend seen in case of plant height. Here, decrease in pseudo-stem girth (cm) of elephant foot yam under sole crop was to the tune of 5.7 to 9.8 per cent as compared to the pseudo stem girth under sole elephant foot yam. maximum pseudo stem girth (17.4 cm) was recorded in sole elephant foot yam may be due to lesser competition for above ground growth factors as compared to the pseudo stem girth of elephant foot yam under millet intercropping systems. Similar results were also reported by Momoko *et* al., 2017. Highest pseudo stem girth reduction of elephant foot yam among millet intercropping systems was noticed in plants under sorghum intercropping system may be due to higher competition for above ground growth factors as compared to finger millet and little millet intercropping systems.

Canopy spread of elephant foot yam under different millet intercropping systems followed the same growth pattern as was noticed for plant height but the highest canopy spread (115.7 cm) was observed in sole elephant foot yam. Reduction in canopy spread of elephant foot yam was in ascending order of sorghum, finger

millet and little millet intercropping systems. Among different millet intercropping systems, lowest reduction was seen under sorghum intercropping system might be due to elephant foot yam plants would have tried to intercept more sunlight for photosynthesis by increasing canopy area.

Table-1. Yield of inter-crops, growth and equivalent yield of elephant foot yam and economics of intercropping systems as affected by elephant foot yam + millet intercropping systems. .

Treatments	Plant height (cm)	Pseudo-stem girth (cm)	Canopy spread (cm)	Sole crop yield (kg/ha)	Inter-crop yield (kg/ha)		EFY Equivalent yield (kg/ha)	Net return (Rs./ha)	B : C ratio
					EFY	Inter-crops			
T1 (Sole EFY)	72.7	17.4	115.7	35233	--	--	34508	669807	1.83
T2 (Sole S)				2602	--	--	3469	50667	0.95
T3 (Sole FM)				1698	--	--	2831	34317	0.68
T4 (Sole LM)				1007	--	--	2014	11620	0.24
T5 (EFY+S)	102.7	15.7	107.7	--	33147	1726	36947	714784	1.82
T6 (EFY+FM)	86.3	16.2	104.0	--	33815	1002	36568	706204	1.81
T7 (EFY+LM)	81.0	16.4	100.3	--	33960	768	36482	704347	1.81
SEm (±)							583	17495	0.056
CD (0.05)							1817	54504	0.174
CV (%)							4.63	7.34	7.41

EFY- Elephant foot yam; S – Sorghum; FM – Finger millet; LM – Little millet

It was also found that there were sizeable reduction in yield of intercrops as compared to their sole crops (Table 1.) may be primarily due to the reduction in plant population of the respective millet intercrops and competition for growth factors like-nutrients, moisture, sunlight, and space between plants. Among millet intercrops, the highest reduction in the yield of intercrops was for finger millet (41.0 %) followed by

sorghum and little millet. Among intercropping systems, maximum reduction (5.9 %) in the yield of elephant foot yam was recorded under sorghum intercropping with elephant foot yam. Highest tuber yield of elephant foot yam was recorded under sole crop of elephant foot yam. Similar results were also reported by Samima *et* al., 2020 and Botuku *et* al., 2024.

Equivalent yield of elephant foot yam was significantly affected by different intercropping systems of millets with elephant foot yam. Equivalent yields of elephant foot yam intercropped with sorghum, finger millet and little millet were found significantly superior than their respective sole crops. Among millet intercropping with elephant foot yam, highest value of elephant foot yam equivalent yield (36947 kg) was estimated under elephant foot yam + sorghum intercropping system than finger millet and little millet intercropping systems may be due to comparatively higher productivity of sorghum. Among sole crops, elephant foot yam equivalent yield of sole elephant foot yam was significantly higher than that of different millet sole crops. Similar results were also reported by Nedunchezhiyan, 2014.

Net return and B:C ratio worked out was also significantly influenced by different intercropping systems and sole crops (Table 1.). Among intercropping systems, highest net return (Rs.714784.00) and B:C ratio (1.82) were realized under elephant foot yam + sorghum and the lowest value of net return was found under elephant foot yam + little millet intercropping system. Net return and B:C ratio followed the same trend as was seen in elephant foot yam equivalent yield. Among sole crops, net return and B:C ratio of sole elephant foot yam was significantly higher than that of different millet sole crops. Net returns and B:C ratio estimated for sole elephant foot yam and all the three intercropping systems with sorghum, finger millet and little millet were found non-significant but their net returns and B{C ratios were significantly higher than that of the net returns and B:C ratios of all the three sole millet crops.

CONCLUSION

On the basis of findings of the experiment, it can be concluded that millets like sorghum, finger millet and little millet can be grown successfully as intercrops with elephant foot yam for diversification of crops, profitability and sustainability of the intercropping system as compared to sole cropping.

ACKNOWLEDGEMENT

Author is hearty grateful to Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur (Bihar) and All India Coordinated Research Project on Tuber Crops, ICAR- Central Tuber Crops Research Institute (ICAR-CTCRI), Thiruvananthapuram, Kerala for their financial and technical support. Author is also very much grateful to all those for their direct and indirect helping hands during the experimentation.

REFERENCES

1. Botuku Narendra, Mamatha K., Padma E. and Sujatha R.V. (2024). Growth and yield of elephant foot yam in millet-based cropping systems under Godavari alluviums of Andhra Pradesh. *International Journal of Research in Agronomy*. 2024; 7(9): 731-734
2. James George and Sunitha, S. (2018). Tropical Tuber Crops : Potential and Prospects. Westvill Publishing House, New Delhi.pages : 01-11.
3. Momoko T, Devi LS, Ravikiran T, Devi AB, James KH. Growth, physiological studies and yield of taro (Colocasia esculenta Schott) cv. Mukhi Pan as influenced by intercropping and row pattern under Manipur condition. Int J Curr Microbiol Appl Sci. 2017;7(5):925-931.
4. Mukherjee, Archana, Immanuel Sheela, Prakash, P., Jaganathan, D. and Sivakumar, P.S. (2020). Root and tuber crops: Life saving future crops. KERALA KARSHAKAN *e-journal*, JUNE 2020; pages : 27-33.
5. Nedunchezhiyan M. (2014). Production potential of intercropping spices in elephant foot yam (*Amorphophallus paeoniifolius*). *Indian J. Agron*. 2014; 59(4):596-601.
6. Samima S, Rakesh R, Das B, Mondal A, Rahman FH. Vegetable-based multitier cropping system: A model for higher income for the farmers in old alluvial soils of West Bengal. Adv Res. 2020;21(6):30-34.
7. Singh, R.S., Pandey, I.B., Choudhary, C.S., Kumar, A., Narayan, A. and Kumar, M. (2022). Response of Row Ratio in Mustard (*Brassica juncea* L.) + Faba bean (*Vicia faba* L.) Intercropping on Growth, Yield of Crops, System Productivity and Economics. *Legume Research*. DOI: 10.18805.