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Effect of Intercropping and Nutrient Management on Weed Control and Yield in Cassava Based Production Systems

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

A field experiment was conducted to evaluate the effect of red gram intercropping and nutrient management practices in cassava on weed control and yields at the College of Agriculture, Vellayani during May 2022 to May 2023. The experiment was laid out in randomised block design with three replications and ten different nutrient management practices (different doses of recommended dose of fertilizer and plant growth promoting rhizobacteria) and a control of no nutrient addition in cassava. The results revealed that intercropping was effective in limiting weed population compared to the sole cropping and were significant from second month after planting. Yield of the intercropping system computed as cassava equivalent yields and economics were higher for treatments involving PGPR application.

Keywords: Biological efficiency cassava; intercropping; red gram; weeds.

1. INTRODUCTION

Tuber crops are becoming increasingly important as climate resilient crops in the context of climate change and are also essential for ensuring food and nutritional security. Among the tropical tuber crops, cassava occupies a prime position in terms of area and production in Kerala. The cassava growing area in Kerala accounts for about 0.64 lakh ha (GOK, 2023), accounting for around 39 per cent of total cassava growing area in India.

The impact of weeds on growth, yield and quality of crops varies with the crop type and locality. Weeds vary in distribution and infestation levels across seasons and regions. Some weeds are crop and location specific and weeds occurring in one region in a particular crop may not occur in another region. Gradual primary growth in cassava accelerates crop-weed competition in cassava and the cost of hand weeding is a major constraint in cassava production. The yield drop in cassava range from 20-50 % due to weed competition (Velmurugan et al., 2017). Intercropping in cassava is a viable option to reduce the weed pressure.

Cassava being an 8-9 month crop with wider spacing and slow initial growth, offer scope for intercropping. Intercropping has several advantages including increased food security, weed control, soil moisture conservation and enhanced biological efficiency. Several crops were reported as suitable for intercropping in cassava. Among the crop categories, cereals (Olorunmaiye et al., 2013), legumes (Jones and Issaka, 2017), vegetables (Olasantan, 2008), medicinal plants (Samson, 2019) and fodder grasses (Gayathri, 2010) were reported as promising intercrops in cassava.

Introduction of a legume as an intercrop in cassava is beneficial in many aspects. Pulses are essential for meeting the protein requirements of the population. The need for improving pulse production in the state calls for exploiting the existing cropping systems and inclusion of grain legumes as intercrops or sequential crops. Furthermore, legumes ensure better soil coverage, reduce light penetration and thereby reduces weed growth. In this background, the present study was conducted to assess the effect of intercropping on weed control and biological efficiency of the system.

2. MATERIALS AND METHODS

The field experiment was conducted from May 2022 to May 2023 at a farmer's field in agro ecological unit 8, which is located at 8˚ 25' 3" North latitude, 77˚ 1' 39" East longitude at an altitude of 28 m above MSL. The experiment was laid out in randomised block design with 10 treatments and a control, replicated thrice. The treatment details are as follows.

T_1 -100 % recommended dose of fertilizers (RDF)
T_2 - 100 % RD N and P + 50 % K
T_3 - 100 % RD N and P + 25 % K
T_4 - 100 % RD N and P + 0 % K
T_5 - 50 % RDF
T_6 - 50 % RDF + PGPR Mix 1
T_7 - 50 % RD N and P + 25 % K
T_8 - 50 % RD N and P + 25 % K + PGPR Mix 1
T_9 - 50 % RD N and P + 0 % K
T_{10} - 50 % RD N and P + 0 % K + PGPR Mix 1
Control - no fertilizer application

The RDF for cassava is 100:50:100 kg NPK ha^{-1}. Urea, rajphos and muriate of potash were used as the respective sources for nitrogen (N), phosphorus (P) and potassium (K). The entire dose of P and 1/3 dose of N and K were applied as basal and the remaining N and K were top dressed in two equal splits at 2 months after planting (MAP) and 3 MAP. Farm yard manure (FYM) @ 12.5 t ha^{-1} was applied to all the treatments. The liquid biofertilizer, PGPR Mix 1 @ 5 % (250 mL per plant) was applied thrice, as basal, at 2 and 4 MAP. The intercrop red gram was fertilized separately, based on soil test results, to ensure an NPK dose of 40:80:40 Kg ha^{-1}.

Before planting cassava, all the plots were sown with green manure cowpea seeds @ 25 kg ha^{-1} and the green manure biomass was incorporated into the field at the time of 50 % flowering. After three weeks of incorporation, based on soil test results, the plots were limed @ 850 kg ha^{-1}. The setts of the cassava variety Sree Pavithra were planted on the mounds at a spacing of 90 cm × 90 cm and the seeds of red gram variety APK- 1 were dibbled in line at a spacing of 20 cm between the plants, accommodating a single row between two rows of cassava. Sole crop of cassava and red gram were raised as per recommended cultural practices and nutrient management. Red gram plants were harvested two times by picking the mature pods and this was completed by 5 MAP. Red gram residues after the harvest were incorporated into the mounds. Cassava tubers were harvested at 9 MAP.

Weed density and weed dry weight were taken at monthly intervals till 3 MAP. A quadrant of 50 × 50 cm size was thrown randomly into each plot and the weeds inside the quadrant was uprooted and counted separately as grasses, sedges and broad leaved weeds. The collected weeds were cleaned by removing the soil particles, shade dried and then oven dried at 80 ^{0}C until a constant weight was obtained and expressed as weed dry weight. Weeds emerged in the field were removed by hand weeding after taking observations on weed density and dry weight. Earthing up for cassava was also done along with weeding.

The productivity of the system was computed in terms of Cassava Equivalent Yield (CEY) and economics, based on cost of cultivation and gross returns as Benefit: cost ratio. The CEY of intercropping system was calculated by the following formula:

$$\text{Cassava Equivalent Yield} = \text{Cassava tuber yield} + \frac{\text{Seed yield of red gram} \times \text{Market price of red gram}}{\text{Market price of cassava}}$$

3. RESULTS AND DISCUSSION

The population of weeds in the different treatments were identified and categorised into monocots and broad leaved weeds. Sedge counts were not at all prominent. The major monocot weeds included goose grass (*Eleusine indica*), East Indian bristle grass (*Setaria barbata*) and barnyard grass (*Echonochola crusgalli, Echonochola colona*). Among the broad leaved weeds, spreading hogweed *(Boerhavia diffusa*), water primrose (*Ludwigia perennis*), *Alternanthera sessilis* and *Cleome rutidosperma* were the dominant. The weed density and dry matter accumulation recorded are presented in Tables 1 and 2. The weed observations varied significantly with the nutrient management practices adopted in cassava. During the first month, weed density varied from 54.67 to 141.33 per m^2 in grasses and 106.67 to 202.67 per m^2 for broad leaved weeds, but remained comparable. In the latter there was no significant difference at 2 and 3 MAP.

The practice of intercropping could reduce the weed population from 2 MAP onwards. Significantly highest grassy weed population was noted in sole cropped cassava (48.00 no.m^{-2}) at 2 MAP. The reduction in weed density of grasses due to intercropping ranged from 55 - 94 per cent. The regulatory effect of intercropping was visible at 3 MAP also, wherein all the intercropped treatments recorded lower and comparable grass weed density and sole cropped cassava had the highest (8 no.m^{-2}) grass weed density. The results obtained were in conformity with the findings of Musambasi et al. (2002) and Samson et al. (2018). Ravi et al. (2021) identified intercropping as a useful strategy for weed management since the legume intercrops have the ability to suppress weed growth, particularly during the early stages of cassava. They ascribed the weed suppressive ability of intercropping to the enhanced shading produced by both the main crop and the intercrop when compared to cassava alone. Padmapriya et al. (2008) attributed the reduced weed growth to the better canopy coverage and lowered light penetration to soil on account of the legume intercrop. However, the weed density of broad leaved weeds did not differ markedly despite a 2 - 4 fold increase in broad leaved weed population in sole cropped cassava compared to intercropping.

Table 1. Influence of intercropping on density and dry matter of grass weeds at different intervals

Treatments	Weed density (no. m^{-2})			Weed dry weight (g m^{-2})		
	1 MAP	2 MAP	3 MAP	1 MAP	2 MAP	3 MAP
T_1	*100.00 (9.94)	21.33 (4.72)	2.67 (1.82)	146.24 (12.11)	3.61 (2.15)	0.05 (1.03)
T_2	74.67 (8.55)	4.00 (2.08)	1.33 (1.41)	97.09 (9.89)	2.08 (1.68)	0.05 (1.03)
T_3	57.33 (7.63)	4.00 (2.08)	1.33 (1.41)	79.73 (8.91)	2.56 (1.80)	0.07 (1.03)
T_4	96.00 (9.62)	9.33 (3.15)	1.33 (1.41)	101.48 (10.11)	1.11 (1.45)	0.04 (1.02)
T_5	61.33 (7.66)	17.33 (4.19)	1.33 (1.41)	63.48 (7.66)	1.87 (1.66)	0.03 (1.01)
T_6	101.33 (10.12)	17.33 (4.28)	2.67 (1.82)	101.24 (9.92)	3.33 (1.99)	0.16 (1.07)
T_7	92.00 (9.61)	4.00 (2.24)	0.00 (1.00)	55.48 (7.35)	1.25 (1.46)	0.00 (1.00)
T_8	68.00 (8.30)	14.67 (3.80)	2.67 (1.82)	95.77 (9.83)	2.40 (1.83)	0.13 (1.06)
T_9	98.67 (9.96)	6.67 (2.19)	0.00 (1.00)	122.88 (11.10)	0.27 (1.11)	0.00 (1.00)
T_{10}	141.33 (11.74)	10.67 (3.32)	2.67 (1.82)	247.47 (15.74)	3.69 (2.17)	0.09 (1.05)
Control	54.67 (7.45)	2.67 (1.82)	2.67 (1.82)	88.35 (9.45)	1.92 (1.63)	0.35 (1.16)
Sole cassava	114.67 (10.75)	48.00 (6.87)	8.00 (2.95)	92.36 (9.50)	5.61 (2.49)	0.48 (1.22)
SE m (±)	17.84 (0.91)	4.99 (0.65)	1.33 (0.38)	16.97 (0.89)	0.98 (0.29)	0.08 (0.04)
CD (0.05)	-	14.63 (1.911)	3.896 (-)	49.781 (2.609)	-	0.235 (0.105)

*original values and transformed values are in parenthesis

The weed dry weights varied with the treatments in intercropping. As in case of weed density, the influence was significant from second MAP only. Weed dry matter of grasses was significantly the highest (247.47 g m^{-2}) for treatment T_{10} (50 % RD N and P + 0 % K + PGPR Mix 1 liquid) at 1 MAP. Intercropping of red gram could not affect the dry weight of grass weeds during 1 MAP compared to sole crop of cassava. This might be due to slow initial growth of both cassava and red gram at 1 MAP. Closely spaced crops with early canopy closure are more effective in regulating weeds under intercropping system (Taah et al., 2017). Early growth in red gram is slow and this would have permitted the weed flora to flourish with minimum competition during the initial stages. Kaur et al. (2015) also suggested that crops with slow early development acts as smother crops only after attaining 6 - 8 weeks of growth.

On the contrary as growth advanced, the weed growth was adversely affected (Table 2). All the intercropping treatments except control could significantly reduce grass weed dry weight at 3 MAP, compared to that in sole cropped cassava (0.48 g m^{-2}). In case of broad leaved weeds, the treatment effects were significant only during 2 MAP. In the present study, growing of red gram in the interspaces of cassava could significantly reduce dry weight of broad leaved weeds to about 72 to 91 per cent over sole cassava at 2 MAP. Zuofa et al. (1992) opined that legume intercrops are more efficient in smothering weeds once they are well established in the field. The results in the experiment corroborate the reported findings. Integration of soya bean in cassava significantly reduced weed dry biomass by 64 per cent within 8 weeks after planting (Taah and Adu, 2021) and inclusion of groundnut in cassava reduced weed dry weight by 31 per cent (Soares et al., 2024). The reduction in weed dry weight could be attributed to the vast surface area covered by legumes and cassava, which inhibited weed growth and development.

Table 2. Effect of intercropping on density and dry matter of broad leaved weeds at different intervals

Treatments	Weed density (no. m^{-2})			Weed dry weight (gm^{-2})		
	1 MAP	2 MAP	3 MAP	1 MAP	2 MAP	3 MAP
T_1	*152.00 (12.37)	16.00 (4.12)	1.33 (1.41)	89.03 (9.41)	2.01 (1.73)	0.05 (1.03)
T_2	176.00 (13.22)	32.00 (5.75)	2.67 (1.82)	98.80 (9.81)	3.32 (2.05)	0.09 (1.05)
T_3	182.67 (13.47)	30.67 (5.47)	2.67 (1.67)	101.20 (9.96)	3.44 (2.05)	0.07 (1.03)
T_4	176.00 (13.28)	17.33 (4.12)	1.33 (1.41)	81.20 (9.06)	2.35 (1.83)	0.11 (1.05)
T_5	165.33 (12.80)	9.33 (3.02)	2.67 (1.67)	90.55 (9.30)	1.19 (1.47)	0.21 (1.09)
T_6	177.33 (13.35)	20.00 (4.57)	1.33 (1.41)	105.20 (10.12)	1.99 (1.72)	0.03 (1.01)
T_7	113.33 (10.63)	17.33 (4.17)	2.67 (1.82)	62.43 (7.89)	1.08 (1.42)	0.19 (1.09)
T_8	174.67 (13.22)	21.33 (4.60)	2.67 (1.82)	68.96 (8.01)	1.77 (1.64)	0.07 (1.03)
T_9	113.33 (10.66)	29.33 (5.33)	1.33 (1.41)	54.08 (7.32)	3.44 (2.09)	0.07 (1.03)
T_{10}	152.00 (12.34)	30.67 (5.62)	1.33 (1.41)	61.87 (7.68)	4.43 (2.33)	0.05 (1.03)
Control	106.67 (9.81)	26.67 (5.25)	0.00 (1.00)	94.15 (9.29)	2.68 (1.86)	0.00 (1.00)
Sole cassava	202.67 (14.24)	41.33 (6.24)	6.67 (2.75)	115.71 (10.80)	12.75 (3.66)	0.33 (1.15)
SE m (±)	22.99 (1.01)	6.09 (0.61)	1.50 (0.41)	22.49 (1.31)	1.23 (0.24)	0.08 (0.04)
CD (0.05)	-	-	-	-	3.599 (0.703)	

$*$ *original values and transformed values are in parenthesis*

Table 3. Effect of different treatments on CEY and economics of intercropping system

Treatments	CEY (Mg ha^{-1})	NR (₹ ha^{-1})	BCR
T_1 - 100 % RDF	35.28	136958.70	1.61
T_2 - 100 % RD N and P + 50 % K	31.31	30290.83	1.04
T_3 - 100 % RD N and P + 25 % K	33.52	113271.34	1.13
T_4 - 100 % RD N and P + 0 % K	27.19	22845.28	0.97
T_5 - 50 % RDF	28.84	27537.78	1.03
T_6 - 50 % RDF + PGPR Mix 1 liquid	40.12	228748.95	1.24
T_7 - 50 % RD N and P + 25 % K	28.03	5733.78	1.01
T_8 - 50 % RD N and P + 25 % K + PGPR Mix 1 liquid	39.17	164808.56	1.18
T_9 - 50 % RD N and P + 0 % K	26.39	-41056.00	0.95
T_{10} - 50 % RD N and P + 0 % K + PGPR Mix 1 liquid	44.96	329379.96	1.35
Control (No fertilizer application)	16.90	-243932.88	0.68

The productivity of the system was assessed in terms of crop equivalent yields in terms of cassava, this being the base crop of the system. It is evident from Table 3 that yields were the maximum (44.96 Mg ha^{-1}) in treatment T_{10} (50 % RD N and P + 0 % K + PGPR Mix 1 liquid), nearly 2.6 fold more than the CEY in control treatment. This brings to focus the competitive interaction that exists in cassava+ red gram intercropping system and the poor performance as well as choice of red gram as intercrop in cassava. It is interpreted that although sole crop was fertilized at 100 % RDF as in T_1, in the latter the presence of the intercrop created competition for the available resources which affected the performance of both components in the system leading to lower yields.

Net returns for different treatments were worked out and the result on the same is presented in Table 3. Among the treatments, T_{10} had the highest net returns (₹ 3,29,379.96 ha^{-1}), followed by T_6 (₹ 2,28,748.95 ha^{-1}) and T_8 (₹1,64,808.56 ha^{-1}), indicating the economic benefits of PGPR application. Higher net returns obtained with these treatments could be attributed to the increased yield from cassava plants grown in these treatments. Even though the cost associated with cultivation of cassava was more in these treatments due to PGPR application, it was compensated by the higher yield obtained in these treatments.

Benefit: cost ratio (BCR) worked out based on gross returns and total cost of cultivation revealed monetary advantage of intercropping in almost all the treatments except T_4, T_9 and control. Lower yields associated with these treatments might led to lower B: C ratios. Higher BCR obtained in treatments T_{10}, T_6 and T_8 could be due to greater net returns from these treatments as a result of higher tuber yield. Suja and Sreekumar (2015) also found that intercropping cassava with vegetable cowpea resulted in larger economic benefits in terms of a BCR of 1.54.

4. CONCLUSION

The present experiment evaluated the effect of intercropping on weed control and biological efficiency of the system. Based on the results it can be concluded that the weed smothering efficiency of red gram was effective from 2 MAP onwards but competition among component crops lowered the efficiency of the system in terms of CEY and economics.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that no generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

Gayathri, P. (2010). *Alley cropping in cassava (Manihot esculenta Crantz) for food - fodder security* (M.Sc. (Ag) thesis). Kerala Agricultural University, Thrissur, 125p.

GOK [Government of Kerala]. (2023). *A compendium of agricultural statistics, Kerala*. Directorate of Agriculture Development and Farmers Welfare, 464p.

Jones, M. T., & Issaka, R. N. (2017). Effects of fertilizer and cassava-legume cropping systems on root yields in two agro-ecological zones of Ghana. *African Journal of Plant Science, 11*, 377–384.

Kaur, R., Raj, R., Das, T. K., Shekhawat, K., Singh, R., & Choudhary, A. K. (2015). Weed management in pigeonpea-based cropping systems. *Indian Journal of Weed Science, 47*(3), 267–276.

Musambasi, D., Chivinge, O. A., & Mariga, I. K. (2002). Intercropping maize with grain legumes for *Striga* control in Zimbabwe. *African Crop Science Journal, 10*, 163–171.

Olasantan, F. O. (2008). Cassava cultivation management for sustainable vegetable production in intercropping with okra. *Journal of Sustainable Agriculture, 27*(2), 53–68.

Olorunmaiye, P. M., Lagoke, T. O., Adigun, J. A., & Orija, O. R. (2013). Effect of intercropping with maize on weed diversity in cassava. *Environmental and Experimental Biology, 11*, 189–193.

Padmapriya, S., Balasubramanian, R., & Sathiyamurthy, V. A. (2008). Weed management studies in cassava (*Manihot esculenta* L.) intercropping systems under irrigated conditions. *Journal of Horticultural Sciences, 3*(2), 141–145.

Ravi, V., Suja, G., Saravanan, R., & More, S. J. (2021). Advances in cassava-based multiple-cropping systems. In I. Warrington (Ed.), *Horticultural Reviews* (Vol. 48). John Wiley & Sons, Inc.

Samson, D. (2019). *Medicinal plants as intercrops in cassava (Manihot esculenta*

Crantz) (MSc (Ag) thesis). Kerala Agricultural University, 151p.

Soares, M. B. B., Finoto, E. L., da Silva, E. S., de Albuquerque, J. A. A., & Dionisio, L. F. S. (2024). Intercropping spatial arrangements affect pest incidence and agronomic aspects of cassava for industrial use. *Agricultural Sciences*. Retrieved March 10, 2025, from http://dx.doi.org/10.1590/1413-7054202448000724

Suja, G., & Sreekumar, J. (2015). Crop diversification with short-duration cassava (*Manihot esculenta*) in the humid tropics for agronomic and economic benefits. *Indian Journal of Agricultural Sciences, 85*(12), 1619–1634.

Taah, K. J., & Adu, E. O. (2021). Relative time of planting of legumes (cowpea, soybean and groundnut) on weed suppression and yield in cassava cropping system. *African Journal of Agricultural Research, 17*(1), 189–197.

Taah, K. J., Buah, J. N., & Adu, E. (2017). Evaluation of spatial arrangement of legumes on weed suppression in cassava production. *Journal of Agricultural and Biological Science, 12*(1), 1–11.

Velmurugan, M., Pugalendhi, L., & Manickam, S. (2017). Effect of weed management practices on the growth and yield of cassava (*Manihot esculenta* Crantz). *Journal of Root Crops, 43*(1), 34–38.

Zoufa, K., Tariah, N. M., & Isirimah, M. O. (1992). Effects of groundnut, cowpea and melon on weed control and yields of intercropped cassava and maize. *Field Crops Research, 28*, 309–314.

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