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Frontline demonstration of intercropping of maize + redgram (8:1) in rain fed areas for higher yield and income in central dry zone of Karnataka

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Abstract

Frontline demonstration on intercropping technology in Maize + Redgram (8:1) was conducted during 2024 and 2025 for two years in the two villages Guttidurga and Kalledevarapura of Jagalur taluk during the *kharif* season under the jurisdiction of ICAR-Taralabalu Krishi Vigyan Kendra, Davanagere. The integrated crop management practices (ICM) with high yielding variety of Redgram (TS-3R), private hybrid maize, seed treatment with bio fertilisers (*Azospirillum*, *Rhizobium* and *Phosphorus solubilising bacteria*), spraying of water soluble fertilisers (pulse magic), integrated weed and pest management were practiced. The results of the demonstration with ICM practices showed higher yield 70.43qha⁻¹ when compared to the farmer practice (Non-ICM), which recorded 60.03qha⁻¹. The average percent increase in Maize Equivalent Yield (MEY) is 12.57 over the years from front line demonstrations (ICM) compared to farmer practice (Non-ICM) plots. However, during the year 2025-26, the per cent increase in MEY was 16.80. Average gross return, net return and benefit cost ratio were ₹ 165078, ₹ 77910 ha⁻¹ and 1.91 respectively in demonstration plot (ICM) as against ₹ 146840, ₹ 58868 ha⁻¹ and 1.68 in farmer practice (Non-ICM). The percent incidence of FAW in maize and Pod borer in red gram were 4.985 and 6.725 respectively in demonstration plot. Intercropping of pulses in cereals is a climate resilient technology and improved production practices will improve the benefit cost ratio. This proven technology will be spread among the farming community for sustainable yield with improved soil fertility.

Keywords: Intercropping, maize, red gram, water soluble fertilisers pulse magic

Introduction

Globally maize (*Zea mays* L.) is one of the important cereal crops. In India, it ranks third after rice and wheat. Maize is the major source of starch and is cultivated mainly in the Western Hemisphere; it is widely used as animal feed. In India, it is grown on an area of 11.5 million ha with a production of 42.22 million tons and with a productivity of 3740 kg ha⁻¹ (Anon.2023). In Karnataka, maize is grown on an area of 1.91 million ha with a production of 6.88 million tons and a productivity of 3160 kg ha⁻¹ (Anon., 2023). Red gram (*Cajanus cajan* L. Mill sp.) is an important food-legume and pulse crop of India. In India, Red gram occupies an area of 5.05 million ha, with the production of 4.34 million tonnes and an average productivity of 804-861 kg ha⁻¹ (Anon.2025). Karnataka occupies an area of 1.3 million ha with a production of 1.1 million tonnes and productivity of 640 to 780 kg ha⁻¹. The intercropping technology is an age old technology where farmers will grow two or more crops on the same piece of land. Pulses play a very important role in maintaining soil fertility by fixing atmospheric nitrogen through bio fertilizers viz., *Rhizobium* spp. with symbiotic relationship. The intercropping concept mainly focuses on getting increased total productivity per unit area and time, utilisation of the farming critical input

like fertilisers, labour and of land resources in rainfed farming. Maize crop is usually sown in the month of June along with Red gram which is a climate resilient technology. The intercropping system is best for the rainfed areas where there will be a single crop. The land will remain fallow if we grow maize as a sole crop during the *kharif* and, in order to utilise the land resources effectively, intercropping is the best option.

Materials and Methods

The present investigation of frontline demonstrations (FLDs) on Intercropping of Maize + Redgram was conducted by ICAR- Taralabalu Krishi Vigyan Kendra, Davanagere in villages namely Guttidurga and Kalledevarapura of Jagalur taluk, Davanagere district of Karnataka state during the *kharif* season of 2024-25, and 2025-26 respectively. The demonstration of intercropping technology with integrated crop management practices (ICM) conducted in an area of 10 ha every year in two locations against the intercropping with non-integrated crop management practices as a check. 50 demonstrations were conducted in an area of 20 ha with active participation of the farmers and farm women to demonstrate the improved production technology in intercropping of maize + redgram

in selected villages to increase the production and expand the area in the district with good agriculture practices. The demonstration ICM practices technology and farmers practice Non-ICM technology were given in Table 1. The soil type of the selected villages was red and sandy loam. Farmers were trained to follow the package of practices for intercropping system of Maize + Redgram as recommended by the Keladi Shivappa Nayaka University of Agriculture and Horticulture Sciences, Shivamogga. Pre sowing off campus training programs were organised with selected farmers for demonstration. The red gram variety selected for intercropping with maize was TS-3R, which is resistant to wilt and medium duration variety. Critical inputs along with technologies like seed treatment with bio fertilisers, organic and inorganic fertilizer application, Micro nutrient application and spraying of water soluble fertilisers (13:00:45, and pulse Magic) water and weed management, integrated pest and disease management etc., were demonstrated at every stage of the crop with suitable trainings and method demonstrations. (Table. 1) Regular field visit by the scientist and line department officials helped in proper execution of demonstration as well as collecting farmer's opinion on the integrated crop management practices followed in Maize+ Redgram

intercropping system. Field days were conducted involving demonstration holding farmers, progressive farmers of villages and adjacent villages, Scientists from University, Officials from line Department of Agriculture and local extension functionaries like krishi sakhis to show case the technologies used in the field. The yield and yield attributes data were collected from the demonstration and check plots. The data with respect to grain yield from FLD plots and farmer's plots of the area were collected and evaluated. The formulae adapted for calculation were:

- Extension gap = Demonstration yield - Farmers' practice yield
- Technology gap = Potential yield - Demonstration yield
- Maize Equivalent Yield (MEY) was calculated by considering prices of two crops with the following formula.

$$\text{MEY for intercrop} = \text{Maize yield} + \frac{\text{Red gram yield} \times \text{Price of Redgram}}{\text{Maize Price}}$$

$$\text{Benefit cost ratio} = \frac{\text{Gross returns (Rs. ha}^{-1}\text{)}}{\text{Gross cost (Rs. ha}^{-1}\text{)}}$$

d.

Table 1: Technology Gap in adoption of improved production practices in intercropping with Maize + Red gram (8:1)

Si. No	Technology	Improved Practices	Farmer Practices	Gap in Adoption (100%)
1.	Cropping system	Intercropping with Maize +Red gram (8:1)	Intercropping with Maize + Redgram	-
2	Seed rate	10 kg/ha 5 kg/ha	20 kg/ha 10 kg/ha	High Seed rate
3	Seed Treatment	Bio fertilisers - <i>Azospirillum</i> (Mazie), <i>Rhizobium</i> and PSB @ 500 g/ha. Bio pesticide - <i>Trichoderma</i> @ 4g/kg	Not Followed	100
4	Macro Nutrients	DAP-130 kg/ha, MOP- 50 kg/ha Urea- 80 kg/ha	DAP-200 kg/ha Urea- 250 kg/ha MOP-50 kg/ha	40
5	Nutrient sprays	13:00:45 @ 5 g/l Pulse Magic @ 5 kg/ha	Not followed	100
6	Micro nutrients	Zinc Sulphate -10 kg/ha	No application	100
7.	Nipping	Nipping - Mechanised	Not practised	100
8	Plant Protection Measures	Integrated Pest Management (Traps installation)	Untimely management	100
9	Harvesting	Mechanical harvesting	Manual Harvesting	100

Results and Discussion

Maize Equivalent yield (MEY)

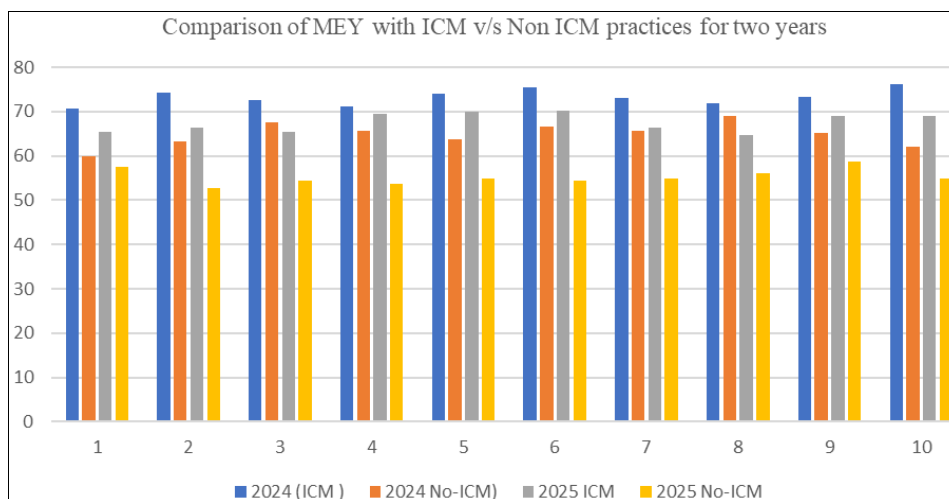
The percent increase in MEY in demonstration (ICM) over farmers practice (Non-ICM) was 8.34 and 16.80 during the years 2024 and 2025 respectively with an average increase of 12.57%. (Table. 2). The highest MEY of 73.25 qha⁻¹ was recorded in demonstration plot during the year 2024-25 as against 67.61qha⁻¹ in farmers practice (Table 3). During the year 2025-26, the demonstration plot recorded the yield of 67.61 qha⁻¹ with farmer practice of 55.22 qha⁻¹. Similar results in maize + red gram intercropping system were reported by Kheroar S *et al.* (2014) [4] and Thimmegowda (2012) [8]. With all the best improved technologies the average yield of the MEY under demonstration plot recorded 70.43 qha⁻¹ in comparison with 60.03 qha⁻¹ in farmers practice (Table 2). The different yield levels

observed in the different years are mainly due to climatic factors such as rainfall, temperature, soil conditions, pest and diseases which influence the crop growth. The test weight of Red gram in demonstration plot was 12.65 and 11.93 over the farmer practice plots that recorded 12.32 and 10.89 during the years 2024 and 2025 respectively. Similar trends were found in the study conducted on intercropping by Shivakumar M. *et al.*, (2020) [7].

The average incidence of fall army worm in maize in demonstration plots were 5.20 and 4.77 over the farmers practice, which observed 11.78 and 7.28 which were found to differ significantly over the years of demonstrations. The same trend was also observed in the redgram crop with pod borer incidence recording the 6.75 and 6.70 in demonstration plots as against 16.28 and 10.98 in farmer practices during the years (Table. 6).

Table 2: Maize Equivalent Yield in demonstration and farmers practice plots (Maize + Redgram)

Year	ICM practices (Maize+ Red gram)	Non-ICM practices (Maize +Redgram)	Increase in yield over Non ICM Practices (%)
2024-25	73.25	64.85	8.34
2025-26	67.61	55.22	16.80
Average	70.43	60.03	12.57



Economics: The average gross return and net return of ₹ 165078 ha⁻¹ and ₹ 77910 ha⁻¹ were recorded for two years in demonstration plot (ICM). The highest gross return and net return of ₹ 175811 ha⁻¹ and ₹ 94495 ha⁻¹ were recorded during the year 2024. Benefit cost ratio of 2.17 and 1.67 recorded in demonstration for the year 2024 and 2025 respectively. Similar trends were also observed by Thimmegowda (2012) ^[8]. (Table 4). In farmer's practice, the average gross return (₹ 146840 ha⁻¹), net returns (₹ 58868

ha⁻¹) and B:C ratio (1.68) were recorded (Shivakumar M. *et al.*, (2020) ^[7]. The difference in the net returns and B:C ratio varies mainly due to fluctuation in the market price of Maize and cost of critical inputs. The additional returns obtained in the demonstration are mainly due to high yielding varieties, Seed treatment with bio fertilizers, use of pulse magic at the time of 50% flowering, installation of pheromone traps and effective management of FAW and pod borer incidences.

Table 3: Statistically analysed the Yield and Test weight in Demonstration (ICM) v/s Farmers Practice (No-ICM) plots

No of Farmers	Maize Equivalent yield (q/ha)		Maize Equivalent yield (q/ha)		Test weight (g) of Red gram		Test weight (g) Red gram	
	2024 (ICM)	2024 No-ICM)	2025 ICM	2025 No-ICM	2024 (ICM)	2024 No-ICM)	2025 ICM	2025 No-ICM
1	70.60	59.82	65.49	57.40	12.85	12.43	11.9	10.89
2	74.30	63.25	66.42	52.70	12.41	12.31	11.89	10.88
3	72.63	67.60	65.50	54.47	12.18	12.18	11.89	10.93
4	71.25	65.58	69.38	53.80	12.92	12.22	11.97	10.94
5	74.09	63.63	70.06	54.88	12.34	12.24	11.88	10.93
6	75.40	66.58	70.21	54.47	12.85	12.53	11.76	10.83
7	73.06	65.76	66.37	54.88	12.83	12.23	11.98	10.96
8	71.83	69.02	64.80	56.02	12.91	12.51	11.98	10.75
9	73.21	65.18	68.96	58.74	12.31	12.22	12.01	10.91
10	76.16	62.05	68.88	54.87	12.9	12.33	12.04	10.88
Average	73.25	64.85	67.61	55.22	12.65	12.32	11.93	10.89
S.Em +/-	1.676		1.419		0.123		0.480	
CD (5%)	5.364		4.542		0.396		0.153	

Table 4: Comparison of Economics of Maize+ Red gram cultivated under Demonstration (ICM) and farmers practice (Non-ICM)

Year	ICM Practices			Non- ICM practices		
	Gross Return (₹ha ⁻¹)	Net Return (₹ha ⁻¹)	B:C	Gross Return (₹ha ⁻¹)	Net Return (₹ha ⁻¹)	B:C
2024-25	175811	94495	2.17	162257	80959	1.97
2025-26	154345	61326	1.66	131423	36777	1.39
Average	165078	77910	1.91	146840	58868	1.68

Table 5: Statistically analysed the incidence of FAW (%) in Maize and Pod Borer (%) in Red gram

No of Farmers	Incidence of FAW (%) in Maize		Incidence of FAW (%) in Maize		Incidence of Pod bore (%) in Red gram		Incidence of Pod bore (%) in Red gram	
	2024 (ICM)	2024 Non-ICM	2025 (ICM)	2025 No-ICM	2024 (ICM)	2024 No-ICM	2025 (ICM)	2025 No-ICM
1	4.99	12.1	4.66	7.32	6.44	16.11	6.41	11.35
2	5.25	11.96	5.25	7.99	6.98	16.01	6.54	11.87
3	5.23	11.87	4.77	6.98	7.01	16.15	6.56	10.1
4	5.14	12.33	4.58	7.15	7.13	16.97	6.87	11.1
5	5.55	11.37	4.83	7.25	6.88	15.98	6.55	10.85
6	4.85	11.18	4.85	6.95	6.8	16.1	6.8	10.56
7	5.3	10.87	4.41	7.3	6.31	16.3	6.96	10.84
8	5.31	11.35	4.91	7.91	6.77	16.89	6.35	10.81
9	5.24	12.33	4.93	7.1	6.61	15.98	6.94	11.01
10	5.14	12.44	4.58	6.85	6.57	16.31	7.02	11.31
Average	5.20	11.78	4.77	7.28	6.75	16.28	6.70	10.98
S.E m +/-	0.307		0.158		0.196		0.268	
CD (5%)	0.983		0.506		0.627		0.859	



General view of Demonstration plots Maize + Redgram (8:1)



Redgram flowering stage suggestion for the spraying of pulse magic 5 g/l

Conclusion

Maize when intercropped with pulses was found to be profitable and beneficial in improving the soil health and monetary benefits. The present investigation revealed that significantly higher maize equivalent yield was recorded with integrated crop management practices as compared to Non-integrated management practices. The use of high yielding and climate resilient variety of red gram, seed treatment with bio fertilisers, IPM practices and spraying of pulse magic had improved the yield over the farmer practices. The impact of this experiment had spread over an area of 5000 ha in davanagere district.

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