Evaluation of Weed Dynamics in Maize based Intercropping Systems for *Rabi* in North Coastal Andhra Pradesh

K. Rajesh[1*]; B. Rajendra Kumar[2]; U. Triveni[3]; S. Govinda Rao[4]

[1,2]Dept. of Agronomy, ANGRAU-Agricultural College, Bapatla-522101 A.P. India.
[3]Scientist (Agronomy), ANGRAU- ARS, Vizianagaram-532001, A.P. India.
[4]Dept. of Statistics & Computer Applications, ANGRAU-Agricultural College, Naira- 532185, A.P. India
*Corresponding Author

Received:- 07 November 2025/ Revised:- 18 November 2025/ Accepted:- 24 November 2025/ Published: 30-11-2025

Abstract— *A field experiment was conducted at the Agricultural College Farm, Naira, during the rabi season of 2024–2025 to evaluate weed dynamics in maize-based intercropping systems under different nitrogen levels. The soil was sandy loam with low fertility status. The study followed a split-plot design with five main plots—maize intercropped with blackgram, greengram, cowpea, in-situ green manuringand sole maizeand three subplots involving 100% RDN, 75% RDN,and 75% RDN + biological fertilizer consortia. Results revealed that maize + cowpea in paired rows significantly reduced weed density and weed dry weight at all crop growth stages. This was attributed to the rapid canopy coverage and shading effect of cowpea, which suppressed weed germination. Sole maize recorded the highest weed density and dry weight, indicating poor weed suppression. Among nitrogen levels, 75% RDN produced the lowest weed density and dry weight, while 100% RDN recorded higher weed growth due to greater nutrient availability. The findings suggest that adopting maize + cowpea intercropping with 75% RDN can effectively reduce weed competition and improve resource efficiency*.

Keywords— Cropping system, intercropping, in-situ green manuring, nutrient uptake and nutrient levels.

I. INTRODUCTION

Maize (*Zea mays* L.) is the third most widely grown crop in India after wheat and rice. In addition to providing human sustenance and high-quality animal feed, maize is utilized as a basic raw material and ingredient in thousands of industrial goods. These include starch, oil, protein, alcoholic beverages, food sweeteners, medications, cosmetics, and the production of bioenergy (Kumar *et al.* 2018). With a productivity of 3351 kg ha^{-1}, maize produces approximately 37.67 million tonnes of grain annually on 11.24 million hectares in India (Directorate of Economics and Statistics, 2023-24). A total of 18.19 lakh tons of production and 6225 kg ha^{-1} of productivity were obtained from the 2.92 lakh hectares of maize planted in Andhra Pradesh (des.ap.gov.in, 2023-24). Intercropping in maize under crop intensification has increased recently in the North Coastal zone of Andhra Pradesh. While fertilization increases crop growth, excessive fertilizer application can exacerbate weed problems. There has been a noticeable improvement in weed control with intercropping systems. In addition to suppressing weeds, the intentional intercropping of legumes with maize aids in the plant's uptake of nitrogen from the atmosphere. Many scientists have also reported increased productivity and returns from intercropping combinations, as well as an improvement in maize yield brought about by the connection of legumes. Conventional spacing restricts the growth of related intercrops but may be beneficial for solitary crops. A reasonable amount of spatial adjustment to make room for intercrops aids in lowering intercrop competition. For successful intercropping, previous research also recommended using wider rows and growing maize in pairs

by Rajashekarappa *et al.* 2018, Singh and Kumar, 2021and Sain *et al.*, 2023.Keeping all these in consideration, present investigation as carried out to study different intercrops with maize at different nitrogen levels to evaluate the weed dynamics in the maize intercropping system in the North Coastal Andhra Pradesh.

II. MATERIAL AND METHODS

An experiment was conducted at Agriculture College Farm, Naira of Acharya N. G. Ranga Agricultural University, Andhra Pradesh, which was geographically situated at $18^0$38'56" N latitude, $83^0$56'38'' E longitude at an altitude of 12m above mean sea level in the Srikakulam district, North Coastal Zone of Andhra Pradesh. The experiment was laid out during *rabi*, 2024-2025in the Block-C of the Agricultural college farm, Naira. The soil of the experimental field was sandy loam in texture, neutral in pH (7.1) with an electrical conductivity of 0.17 dS m^{-1}at 25ºC, low in organic carbon (0.43 %) and available N (248.8 kg ha^{-1}), available P_2O_5 (23.2 kg ha^{-1}) and available K_2O (255.2 kg ha^{-1}). The average mean temperature ranged from 33.5 ^{0}C to 12.2 ^{0}C, with a total rainfall of 73.2 mm in 5 rainy days. The study included fifteen treatments using the following combinations of intercropping systems for maize: The following are M_1: Maize + Blackgram in paired rows, M_2: Maize + Greengram in paired rows, M_3: Maize + Cowpea in paired rows, M_4: Maize + *in-situ* green manuring with sunnhemp, and M_5: Farmer's practice-sole maize were planted in main plots and in subplots with varying nitrogen amounts S_1: 100% RDN, S_2: 75% RDN and S_3: 75% RDN + biological fertilizer consortia. The recommended dose of phosphorus and potassium were applied in the form of Single Super Phosphate (SSP) and Muriate of Potash (MOP) and treatments with 100 % RDN and 75 % RDN had given 240 kg N ha^{-1} and 180 kg N ha^{-1} through urea and Biological fertilizer consortia was applied @ 1250 ml ha^{-1}. The treatments with intercrops has followed a spacing of 80/40 x 20 cm and normal planting of maize followed a spacing of 60 x 20 cm. When required, field operations such as fertilizer application, irrigation and plant protection measures were carried out. The data regarding the nutrient uptake was calculated by the standard procedures and the gross returns, net returns and B:C ratios were also calculated accordingly. Data was analyzed statistically by following the standard procedures as described by Gomez and Gomez (1984).

III. RESULTS AND DISCUSSION

3.1 Weed Density:

In the maize intercropping systems higher weed density was observed at 20 DAS and it went on decreasing at later stages of crop growth. Significantly lower weed density was recorded in maize + cowpea in paired row planting at 20, 40 and 60 DAS (47.70, 28.86 and 21.55 No. m^{-2} respectively). Succeeding to maize + cowpea, lower weed density was observed in maize + black gram (54.58, 41.30 and 29.62 No. m^{-2} respectively) which was comparable with maize + greengram (58.60, 42.62 and 31.65 No. m^{-2} respectively) in paired rows at 20, 40 and 60 DAS. Higher weed density was recorded in sole maize (control) at all intervals of crop growth (65.10, 92.74, 173.30 and 185.92 No. m^{-2} at 20, 40, 60 and at harvest respectively). However, there was no significant difference observed among the weed densities of different intercropping systems at the time of harvest. These studies were in close conformity with Sannagoudar *et al.* (2024), Singh and Kumar (2021) and Singh *et al.* (2025).

Among the nitrogen levels significantly lower weed density was observed with application of 75% RDN (52.93, 54.30, 62.37 and 75.22 No. m^{-2} at 20, 40, 60 DAS and at harvest respectively). Higher weed density (61.32, 62.30, 68.24 and 83.16 No. m^{-2} at 20, 40, 60 and at harvest respectively) was recorded with application of 100 % RDN which was at par with application of 75 % RDN + Biological fertilizer consortia. Rapid weed emergence and growth were encouraged by the increased nutrient availability, particularly when competitive suppression was not present.

TABLE 1
WEED DENSITY (No. m^{-2}) IN MAIZE AS INFLUENCED BY MAIZE BASED INTERCROPPING SYSTEMS AND NITROGEN LEVELS

TREATMENTS	20 DAS	40 DAS	60 DAS	At harvest
Maize based intercropping systems				
M_1: Maize + Blackgram with paired row	7.4	6.46	5.47	7.31
	-54.58	-41.4	-29.62	-52.98
M_2: Maize + Greengram with paired row	7.68	6.56	5.68	7.41
	-58.6	-42.72	-31.65	-55.47
M_3: Maize + Cowpea with paired row	6.93	5.41	4.69	6.95
	-47.7	-28.86	-21.55	-47.56
M_4: Maize + *in-situ* green manuring with sunnhemp	7.52	9.22	8.3	7.43
	-56.14	-84.77	-68.6	-58.82
M_5: Farmer's practice -Sole maize (Control)	8.09	9.65	13.28	13.7
	-65.1	-92.74	-173.3	-185.92
S.Em ±	0.124	0.126	0.157	0.143
CD (P=0.05)	0.41	0.42	0.51	0.47
CV %	10.6	10.8	10.7	10.1
Nitrogen Levels				
S_1 : 100 % RDN	7.81	7.67	7.71	8.78
	-61.32	-62.3	-68.24	-83.16
S_2 : 75 % RDN	7.29 (52.93)	7.31	7.29	8.33
		-54.3	-62.37	-75.22
S_3 : 75 % RDN +	7.47	7.54	7.45	8.57
Biological fertilizer consortia	-55.63	-58.4	-66.37	-79.89
S.Em ±	0.1	0.091	0.112	0.097
CD (P=0.05)	0.31	0.27	0.33	0.29
CV %	10.2	9.9	10.6	9.8
Interaction				
S.Em ±	0.224	0.203	0.251	0.218
M x S	NS			
S x M	NS			

Note: The data subjected to square root transformation. The figures in parenthesis are original values.

3.2 Weed Dry Weight:

The higher dry weight of weeds was recorded at 20 DAS compared to that of later stages of crop growth. Significantly lower weed dry weight was recorded in maize + cowpea in paired row planting at 20, 40 and 60 DAS (26.98, 18.67 and 15.35 g m-2 respectively). Succeeding to maize + cowpea, lower weed density was observed in maize + black gram (32.53, 22.75 and 18.70 g m-2 respectively) which was comparable with maize + greengram (34.43, 24.05 and 18.92 g m-2) in paired rows at 20, 40 and 60 DAS. Higher weed dry weight was recorded in sole maize (control) at all intervals of crop growth (44.41, 59.32, 72.91 and 92.23 g m-2 at 20, 40, 60 DAS and at harvest, respectively). However there was no significant difference observed in the weed dry weight among the intercropping systems at the time of harvest. Cowpea grew swiftly and spreaded across the soil surface and forms a dense canopy, which reduced the amount of sunlight that reaches the ground. This shadowing effect

makes it difficult for weed seeds to germinate and thrive. These studies were in close accordance with Rajeshkumar *et al.* (2018), Sannagoudar *et al.* (2021)

Among the nitrogen levels significantly lower weed dry weight was observed with application of 75% RDN (32.40, 28.78, 27.24 and 32.71 g m-2 at 20, 40, 60 and at harvest respectively). Higher weed dry weight (39.12, 32.88, 31.32 and 40.09 g m-2 at 20, 40, 60 and at harvest respectively) was recorded with application of 100 % RDN, which was at par with application of 75 % RDN + Biological fertilizer consortia, except at harvest. The greater nitrogen availability in the 100 % RDN and 75 % RDN + Biological fertilizer consortia treatments might be cause of higher weed dry weight at higher nitrogen levels. These studies are in confirmation with Choudhary *et al.* (2014) and Divya *et al.* (2020).

TABLE 2
WEED DRY WEIGHT (g m^{-2}) IN MAIZE AS INFLUENCED BY MAIZE BASED INTERCROPPING SYSTEMS AND NITROGEN LEVELS

TREATMENTS	20 DAS	40 DAS	60 DAS	At harvest
Maize based intercropping systems				
M_1 : Maize + Blackgram with paired row	5.73	4.82	4.34	4.58
	-32.53	-22.75	-18.7	-20.5
M_2 : Maize + Greengram with paired row	5.89	4.95	4.4	4.67
	-34.43	-24.05	-18.92	-21.51
M_3 : Maize + Cowpea with paired row	5.23	4.37	3.96	4.5
	-26.98	-18.67	-15.25	-19.8
M_4 : Maize + *in-situ* green manuring with sunnhemp	6.2	5.38	4.67	5.16
	-38.35	-28.54	-26.51	-24.22
M_5 : Farmer's practice -Sole maize (Control)	6.7	7.72	8.5	9.62
	-44.41	-59.32	-72.91	-92.23
S.Em ±	0.101	0.095	0.094	0.096
CD (P=0.05)	0.33	0.31	0.3	0.31
CV %	9.9	10	10.5	10.3
Nitrogen Levels				
S_1: 100 % RDN	6.28	5.62	5.34	6.04
	-39.12	-32.88	-31.32	-40.09
S_2: 75 % RDN	5.7	5.31	5.03	5.43
	-32.4	-28.78	-27.24	-32.71
S_3: 75 % RDN +	5.86	5.42	5.15	5.64
Biological fertilizer consortia	-34.33	-30.33	-29.4	-35.47
S.Em ±	0.075	0.063	0.06	0.064
CD (P=0.05)	0.22	0.19	0.17	0.19
CV %	9.8	10.1	10.6	10
Interaction				
S.Em ±	0.168	0.141	0.134	0.144
M x S			NS	
S x M			NS	

Note: The data subjected to square root transformation. The figures in parenthesis are original values

IV. CONCLUSION

From the experiment it can be concluded that among the weed indices, significantly lower weed density and lower weed dry weight were recorded under maize + cowpea with paired row planting indicating adoption of higher canopy crops improving weed smothering efficiency. Among the nitrogen levels, lower weed density and weed dry weight were recorded under 75 % RDN application.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

REFERENCES

[1] Choudhary, V.K., Dixit, A., Kumar, P.S and Chauhan, B.S. 2014. Productivity, weed dynamics, nutrient mining, and monetary advantage of maize legume intercropping in the eastern Himalayan region of India. Plant Production Science. 17 (4): 342-352.

[2] Department of Economics and Statistics, 2023-2024. https://des.ap.gov.in

[3] Directorate of Economics and Statistics, 2023-2024. Agricultural Statistics at a Glance.

[4] Divya, R.K., Behera, B and Jena, S.N. 2020. Effect of planting patterns and weed management practices on weed dynamics and nutrient mining in runner bean (*Phaseolus coccineus* L.) + maize (*Zea mays* L.) intercropping. International Journal of Chemical Studies. 8: 2704-2712.

[5] Gomez K A and Gomez A 1984. Statistical procedures for agricultural research. 1st ed. John Wiley Sons, New York.

[6] Kumar, R.S., Bridgit, T.K and Chanchala, A. 2018. Physical and chemical properties of sandy soil as influenced by the application of hydrogel and mulching in maize (*Zea mays* L.). International Journal of Current Microbiology and Applied Sciences. 7(07):3612-3618.

[7] Rajeshekarappa, K.S., Pasha, M.M and Devaraj, K. 2018. Effect of different organic mulches and *in-situ* green manuring on soil chemical, biological properties and weed dynamics in Maize. International Journal of Agricultural Invention. 3 (1): 57-61.

[8] Rajeshkumar, A., Venkataraman, N.S and Ramadass, S. 2018. Integrated weed management in maize-based intercropping systems. Indian Journal of Weed Science. 50(1): 79-81.

[9] Sain, S., Maitra, S., Shankar, T and Sairam, M. 2023. Competitive ability of legume based intercrop for *rabi* maize (*Zea mays* L.) in north eastern ghats of Odisha. Crop Research. 58 (3&4): 136-143.

[10] Sannagoudar, M.S., Murthy, K.N., Ghosh, A., Singh, A.K., Gupta, G., Halli, H.M and Kumar, R.V. 2024. Comparative efficacy of leguminous intercrops and weed management practices on nutrient uptake, productivity and profitability of maize based intercropping system. Legume Research. 47 (9): 1549-1554.

[11] Singh, N and Kumar, R. 2021. Legume intercropping for weed control efficiency in kharif maize (Zea mays L.) under Amritsar conditions. Agricultural Science Digest. 3: 1-4

[12] Singh, A., Sarkar, S. and Kaur, J. 2025. A Sustainable Approach Toward Food Security: Investigating the effect of intercropping on soil rhizospheric activity, weed flora and yield attributes of maize (Zea mays). Nature Environment and Pollution Technology. 24: 223-228.