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Evaluation of Maize based Intercropping System for North Coastal A.P

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ABSTRACT

The field experiment was conducted on sandy loam soil of Agriculture College Farm, Naira during the *Rabi* season of 2021-22 to evolve the most suitable and profitable maize based intercropping systems. Maize with five intercrops *viz.*, Blackgram, Bhendi, Coriander, Watermelon and Marigold were tested. Plant height at tasseling, dry matter production and fresh cob yield of maize was higher with sole maize, found on par to all the inter intercrops on paired rows of maize and were conspicuously higher over various inter intercrops on skipped rows of maize. Among different intercrops, blackgram resulted to higher values of growth and fresh cob yield over bhendi and on par to coriander, watermelon and marigold on paired rows of maize. There were no measurable differences in fresh cob yield among different intercrops on skipped row of maize. The sole maize recorded 80.76% higher fresh cob yield over inter cropping bhendi on skipped rows of maize. On the other hand irrespective of inter crops, skipped row of maize recorded significantly higher values of yield structure of maize like number of cobs plant^{-1}, number of rows cob^{-1}, number of kernels row^{-1}, cob length and cob girth compared to paired rows of maize and the maximum values were obtained with intercropping blackgram on skipped row of maize followed by intercropping coriander on skipped row of maize.

Keywords: *Intercropping, Maize (Zea mays L.), Paired row Skipped row.*

Maize (*Zea mays* L.) is a versatile crop and has been emerging as one of the potential crops that address several issues like food and nutritional security, climate change, water scarcity, farming systems, bio-fuel etc. under changing farming scenario in the country. In Andhra Pradesh, it is grown on 0.30 million hectares, with a total production of 1.95 million tonnes and an average productivity of 6500 kg ha^{-1} (Directorate of Economics and Statistics, 2020-21). As maize has short duration, wide adaptability and compatibility under diverse soil and climatic conditions it is considered as one of the potential drivers of crop diversification under different situation. Yield stagnation in maize for the past few years in Andhra Pradesh due to various reasons challenging the scientists and policy makers to search for options to bring the sustainability to maize farming. Intercropping is one of the most prominent tool and cultivation systems of smallholders and the practice not only enhances system productivity and sustainability but also enhances farmers' income, employment and reduces risks against climatic aberrations and changes. Intercropping maximizes the system productivity as well as resource utilization per unit of land (Iqbal *et al.*, 2019). Planting pattern is an important tool to exploit the potential of intercropping system (Pandey *et al.*, 2019). The objectives of the present study were to evaluate the various intercrops with maize and to identify the most profitable maize based intercropping system in north coastal A.P.

MATERIAL AND METHODS

A field experiment was conducted at Agriculture College Farm, Naira of Acharya N. G. Ranga Agricultural University, during the *Rabi* season of 2021-22. The experiment site was geographically situated at 18^{0}22'56" N latitude, 83^{0}56'38" E longitudes and at an altitude of 12 m above mean sea level in the North Coastal Zone of Andhra Pradesh. The study comprises of 11 treatments *viz.*, T_1- Sole crop of Maize, T_2- Intercropping Blackgram between paired rows of Maize, T_3- Intercropping Bhendi between paired rows of Maize, T_4- Intercropping Coriander between paired rows of Maize, T_5- Intercropping Watermelon between paired rows of Maize, T_6- Intercropping Marigold between paired

rows of Maize, T_7- Intercropping Blackgram on skipped row of Maize, T_8- Intercropping Bhendi on skipped row of Maize, T_9- Intercropping Coriander on skipped row of Maize, T_{10}- Intercropping Watermelon on skipped row of Maize, T_{11}- Intercropping Marigold on skipped row of Maize. The experiment was laid out in Randomized block design and each treatment replicated thrice. The soil was sandy loam having pH 7.1, EC 0.063 dSm^{-1}, organic carbon 0.40 %, available N 234 kg ha^{-1}, available P_2O_5 21.7 kg ha^{-1} and available K_2O 255 kg ha^{-1}. The crops were sown during the third week of January 2022. The cultivars used for the experiment were Maize seed is of hybrid variety - DKC 9150, Black gram seed variety - LBG 787, Bhendi seed variety - Arka anamika, Coriander seed variety - Neelambari, Watermelon seed variety - Arka shyama and Marigold seedling variety - Bengal orange were selected for testing.The various spacing followed *viz.*, Maize (90/30x20 cm – for paired row planting & 60x20 cm – for other treatments), Blackgram (30x10 cm), Bhendi (45x20 cm), Coriander (15x10 cm), Watermelon (90x90 cm) and Marigold (45x20 cm).Field operations such as weeding, fertilizer application, irrigation and plant protection measures were taken as per requirement. The data on highest plant height, dry matter production, no. of cobs $plant^{-1}$, no. of kernel rows cob^{-1}, no. of kernels row^{-1}, cob yield (with husk and without husk), stover yield and grain yield were recorded as per standard procedures. Data was analyzed using ANOVA and the significance was tested by Fisher's least significance difference (p=0.05).

RESULTS AND DISCUSSION

Growth parameters

Results of growth parameters like plant height, and dry matter production of maize (Table 2) revealed that, Maize shown significant difference due to different crop configurations of maize based intercropping system. Perusal of the data revealed that plant height of maize sampled at 30 DAS did not shown significant variation in different crop configurations of maize based intercropping systems as competition between component crops was not triggered by that time. Whereas at tasseling, skipped rows of maize was significantly superior in terms of plant height over paired rows of maize and sole maize due to the fact of less competition for various resources in skipped rows of maize due to the fact of reduction in 50% plant population in skipped rows compared to paired rows and sole cropping of Maize . The maximum plant height was observed with intercropping blackgram on skipped row of maize and it is on par with remaining skipped rows of treatments of maize based intercropping systems.

Dry matter accumulation of maize was measured at tasseling and it was observed that dry matter increased up to the time of harvest (Table 2). At both the stages of sampling, *i.e.*, tasseling and at harvest, significantly maximum dry matter accumulation was recorded with sole maize. Higher dry matter accumulation in sole maize might be due to increased growth structure and have led to increased photosynthetic assimilates in the plant, which finally paved the way for increased dry matter accumulation. Similar findings were reported by Sangtam *et al.* (2019). Regardless to the inter crops, paired rows of maize recorded significantly higher dry matter over skipped rows due to more plants per square meter Rama lakshmi *et al.* (2022) and there was no traceable variation in dry matter accumulation of maize among different intercropping systems in either skipped or paired rows of maize. Among the treatments, the lowest dry matter accumulation was recorded under intercropping bhendi on skipped row of maize. The lowest dry matter accumulation was recorded with intercropping bhendi on skipped row of maize may be due to adverse effect of excessive competition of bhendi on maize. The data pertaining to plant population of maize are presented in Table 1. Plant population was recorded at 30 DAS and at harvest. Irrespective of the treatments, the plant population decreased slightly with the advancement in the crop age. Maize shown significant difference in plant population due to different crop configurations of maize based intercropping system.

Yield attributes

Yield attributes of maize like number of cobs $plant^{-1}$, number of rows cob^{-1}, number of kernels row^{-1}, cob length and cob girth was influenced by different crop configuration of maize based intercropping systems (Table 3). Irrespective of inter crops skipped row of maize recorded significantly higher values of yield structure compared to paired rows of maize and was the maximum number of cobs $plant^{-1}$, number of rows cob^{-1}, number of kernels row^{-1}, cob length and

cob girth were obtained with intercropping blackgram on skipped row of maize followed by intercropping coriander on skipped row of maize. The superior yield structures of maize on skipped rows might be due to availability of more space to individual plant facilitated with availability of more resources at lesser competition However there was no conspicuous variation in yield parameters among different inter crops regardless to the crop configurations. With respect to sole maize the yield parameters were superior to paired rows of maize and significantly inferior to skipped row of maize. Among the treatments, the lowest values of yield structure were recorded with intercropping bhendi on paired rows of maize. The possible reason for lower number of cobs plant^{-1}, number of rows cob^{-1}, number of kernels row^{-1}, cob length, cob girth and cob weight in paired rows maize is due to higher competition among crop plants for light, solar radiation, space, soil moisture and for nutrients during entire crop season as compared to the skipped row of maize and sole maize crop. Similar result of significant influence of crop configuration on yield parameters of corn was reported by Chaudary *et al*. (2018). This finding was corroborating the results of Khanum *et al*. (2019) who reported that maize growth and yield components and its yields were higher in sole cropping than intercropping.

Fresh cob yield

Fresh cob yield of maize was influenced significantly by different crop configuration of maize based intercropping systems (Table 3). The maximum maize fresh cob yield was obtained with sole maize, which was found on par to all the inter intercrops on paired rows of maize and were conspicuously higher over various inter intercrops on skipped rows of maize. The sole maize recorded 80.76% higher fresh cob yield over inter cropping bhendi on skipped rpes of maize. Higher growth and yield structure due to adequate supply of nutrients in the soil making the plant to maintain their chlorophyll content for long time with slower leaf senescence enable to supply photo assimilates for a longer period might have resulted in increased cob yield. Similar findings were reported by Ishaq Rahimi *et al.* (2019), Parimaladevi *et al.* (2019) and Manasa *et al*. (2018). While comparing fresh cob yield of paired rows and skipped rows of maize, there was a distinct evidence of higher fresh cob yield on paired rows of maize over skipped rows regardless to inter crops. Maize fresh cob yield of paired rows of maize intercropping was significantly higher over skipped row of maize intercropping due to 50% reduction in plant population could not compensate the yield of paired rows where 100% plant population was maintained. Among different intercrops blackgram resulted to higher fresh cob yield over bhendi and on par to coriander, watermelon and marigold on paired rows of maize. There were no measurable differences in fresh cob yield among different intercrops on skipped row of maize. The cob yield of maize decreased in all the skipped row intercropping systems compared with the sole crop and paired row intercropping in maize. On the other hand the lowest maize fresh cob yield was recorded under treatments of intercropping bhendi on skipped row of maize. The decrease in maize yield among intercrop treatments may be due to differences in their active growth stages, competitive ability and peak demand for growth factors. Mohan kumar *et al.* (2012) has also reported similar results in maize.

Inter crop yield

The data on Intercrop yield as influenced by different crop configuration of maize based intercropping system have been presented in Table 3. The maximum intercrop yield was obtained with (T_{10}) Intercropping Watermelon on skipped row of Maize. However, intercropping Watermelon on skipped row of Maize was found on par to intercropping watermelon between paired rows of maize. Next best was intercropping watermelon between paired rows of maize. On the other hand the lowest intercrop yield was recorded under treatments of (T_2) Intercropping Blackgram between paired rows of Maize. While comparing intercrop yield of paired rows of maize intercropping and skipped row of maize intercropping, we have a distinct evidence of higher intercrop yield production in skipped rows of maize intercropping treatments.

Table 1. Plant population (ha^{-1}) of maize at different inter cropping systems and sole maize

Treatment details	Initial plant population	Final plant population
T1- Sole crop of Maize	81096	79630
T2-Intercropping Blackgram between paired rows of Maize	80327	79142
T3- Intercropping Bhendi between paired rows of Maize	79889	78883
T4- Intercropping Coriander between paired rows of Maize	80376	79216
T5- Intercropping Watermelon between paired rows of Maize	80197	78756
T6- Intercropping Marigold between paired rows of Maize	80481	78858
T7- Intercropping Blackgram on skipped row of Maize	39197	38580
T8- Intercropping Bhendi on skipped row of Maize	39275	38293
T9- Intercropping Coriander on skipped row of Maize	39120	38296
T10- Intercropping Watermelon on skipped row of Maize	39583	38426
T11- Intercropping Marigold on skipped row of Maize	38713	37503
SEm+	**1339**	**1084**
C.D	**3950**	**3199**
C.V	**3.76**	**3.1**

Table 2. Growth parameters of maize at different inter cropping systems and sole maize

Treatment details	Plant height (cms)		Dry matter	
	30 DAS	At Tasseling	At Tasseling	At Harvest
T1- Sole crop of Maize	83.4	227.4	10987	20555
T2-Intercropping Blackgram between paired rows of Maize	82	226.9	10963	20037
T3- Intercropping Bhendi between paired rows of Maize	78	218.6	10707	17592
T4- Intercropping Coriander between paired rows of Maize	80.3	224.4	10907	18841
T5- Intercropping Watermelon between paired rows of Maize	79.7	220.4	10867	18669
T6- Intercropping Marigold between paired rows of Maize	79.7	220.8	10820	18566
T7- Intercropping Blackgram on skipped row of Maize	82.9	254.4	5543	12934
T8- Intercropping Bhendi on skipped row of Maize	78.9	246.6	5345	11060
T9- Intercropping Coriander on skipped row of Maize	81.1	251.5	5467	12357
T10- Intercropping Watermelon on skipped row of Maize	80.2	249.5	5386	11838
T11- Intercropping Marigold on skipped row of Maize	79.5	250.2	5363	11788
SEm+	**3**	**7**	**493**	**743**
C.D	**NS**	**20.6**	**1454**	**2192**
C.V	**6.55**	**5.12**	**10.17**	**8.12**

Table 3. Yield attributes and fresh cob yield of maize at different inter cropping systems and sole maize

Treatment details	No. of cobs plant^{-1}	No. of rows cob^{-1}	No. of kernels row^{-1}	Cob length (cm)	Cob girth (cm)	Fresh cob yield (Kg ha-1)
T1- Sole crop of Maize	1.13	14.1	28.2	18.1	14.73	11545
T2-Intercropping Blackgram between paired rows of Maize	1.17	13.9	27.47	17.93	14.47	11356
T3- Intercropping Bhendi between paired rows of Maize	1.03	13.53	24.6	17.2	14.2	10063
T4- Intercropping Coriander between paired rows of Maize	1.1	13.83	27.47	17.77	14.5	10996
T5- Intercropping Watermelon between paired rows of Maize	1.07	13.7	26.07	17.57	14.43	10542
T6- Intercropping Marigold between paired rows of Maize	1.07	13.63	26.6	17.33	14.23	10421
T7- Intercropping Blackgram on skipped row of Maize	1.4	15.87	33.3	20.97	16.67	7945
T8- Intercropping Bhendi on skipped row of Maize	1.3	15.5	30.77	20.03	16.3	6387
T9- Intercropping Coriander on skipped row of Maize	1.37	15.9	32.53	20.5	16.6	7497
T10- Intercropping Watermelon on skipped row of Maize	1.3	15.77	31.6	20.33	16.5	7451
T11- Intercropping Marigold on skipped row of Maize	1.33	15.63	31.17	20.37	16.43	7015
SEm+	**1.13**	**14.1**	**28.2**	**18.1**	**14.73**	**433**
C.D	**1.17**	**13.9**	**27.47**	**17.93**	**14.47**	**1279**
C.V	**8.49**	**5.31**	**5.11**	**5.06**	**5.76**	**8.16**

Table 4. Inter crop yield (kg ha^{-1}) of maize at different inter cropping systems and sole maize

Treatment details	Inter crop yield (kg ha-1)
T1- Sole crop of Maize	0
T2-Intercropping Blackgram between paired rows of Maize	455
T3- Intercropping Bhendi between paired rows of Maize	1850
T4- Intercropping Coriander between paired rows of Maize	2777
T5- Intercropping Watermelon between paired rows of Maize	5822
T6- Intercropping Marigold between paired rows of Maize	3692
T7- Intercropping Blackgram on skipped row of Maize	516
T8- Intercropping Bhendi on skipped row of Maize	2037
T9- Intercropping Coriander on skipped row of Maize	3101
T10- Intercropping Watermelon on skipped row of Maize	6513
T11- Intercropping Marigold on skipped row of Maize	4054
SEm+	**1.34**
C.D	**3.96**
C.V	**8.31**

CONCLUSION

Plant height at tasseling, dry matter production, and fresh cob yield of maize was higher with sole maize, found on par to all the inter intercrops on paired rows of maize and were conspicuously higher over various inter intercrops on skipped rows of maize. Among different intercrops blackgram resulted to higher values of growth and fresh cob yield over bhendi and on par to coriander, watermelon and marigold on paired rows of maize. There were no measurable differences in fresh cob yield among different intercrops on skipped row of maize. The sole maize recorded 80.76% higher fresh cob yield over inter cropping bhendi on skipped rows of maize. On the other hand maximum values of yield structure was noticed with intercropping blackgram on skipped row of maize followed by intercropping coriander on skipped row of maize. Also we have a distinct evidence of higher intercrop yield production in skipped rows of maize than paired rows of maize intercropping treatments.

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