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Response of Maize-Chickpea Sequence to Different Sowing Windows and Nitrogen Management Under Rainfed Conditions

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ABSTRACT

A field experiment was conducted at Regional Agricultural Research Station, Lam, Guntur during *kharif* and *rabi* sessions of 2013-14 & 2014-15 on clay soil to know the response of maize-chickpea sequence to different sowing windows and nitrogen management under rainfed conditions of Krishna zone. Sowing windows and nitrogen levels were significantly influenced by the test weight, harvest index, kernel and stover yield of preceding maize. Maximum test weight, harvest index and kernel and stover yield was obtained when maize was sown on 2nd FN of June with 200 % RDN where as maximum stover and grain yield of succeeding chickpea was recorded when maize sown on 1st FN July with 200 % RDN applied to maize followed by 100 % RDN applied to chickpea.

Key words*: Maize-chickpea sequence, Recommended dose of N and Sowing window*

Improving and maintaining soil health for enhancing and sustaining agricultural production is of utmost importance for India's food and nutritional security. Due to increase in population pressure, the demand for food, feed, fodder, fiber, fuel, pulses and oil seed production is rapidly increasing. To meet the future demand, we would need better planning and management and as well as intensification of crop production. One of the alternatives to achieve this goal is to raise the crop productivity through improved varieties and the matching production technologies to sustain soil fertility, cropping systems and crop productivity in future. Intensive cultivation through the multiple cropping with proper planning in a sustainable way will help in increasing the food grain production for meeting the future demand and requirement. Maize in *kharif* and chickpea in *rabi* is one of the crop sequence in India in both irrigated and rainfed areas. Maize-chickpea sequence will be profitable than sole crop and also helps in soil fertility maintenance on long run in Krishna zone of Andhra Pradesh. If this crop sequence is introduced to the Krishna agro-climatic zone of Andhra Pradesh, it will be beneficial in many ways. Both the crops together require comparatively shorter period and at the same time risk free with secured income to the farmer and sustainable to the soil health. Therefore introduction of maize-chickpea with intensive input management under rainfed conditions of Krishna zone may sustain the economy of the rainfed farmers of the Krishna zone. The yield of maize and chickpea mainly depends on the major agronomic practices ie., time of sowing and nitrogen supply to these crops. The Information on suitable sowing window with appropriate nutrient management on maize-chickpea sequence is meagre in the Krishna agro-climatic zone of Andhra Pradesh. Keeping this in view, the present experiment is proposed

MATERIAL AND METHODS

Field experiment was conducted in 17th block of Regional Agricultural Research Station, Lam Farm located at Guntur (Latitude:$16^0 18^1$, Longitude: $80^0 29^1$, Altitude:33 m.a.m.s.l). The climate is sub-tropical with mean annual rainfall of 950 mm. The soil of experimental field was clay loam in texture, neutral to slightly alkaline in reaction (pH 7.8 to 8.2). The available N, P_2O_5 and K_2O in soil were 204 (low), 96.5 and 886.5 kg ha^{-1} (high), and medium in organic carbon (0.51%) content respectively. The experiment was conducted for two successive *kharif* and *rabi* seasons of 2013-14 & 2014-15 in Krishna agro-climatic zone of Andhra Pradesh. The experiment consisting of three sowing windows as main plots treatments viz., 2nd FN of June, 1st FN of July and 2nd FN of July, three nitrogen levels as sub-plot treatments viz., 100 %, 150 % and 200 % RDN to preceding maize and

Table 1. Test weight, harvest index, grain and stover yield of maize-chickpea sequence at different sowing windows and N levels in maize-chickpea sequence.

Treatments Main Plots:	Test weight (g)		Harvest index (%)		Yield (kg ha^{-1}) Grain		Stover	
Sowing windows (A)	2013	2014	2013	2014			2013	2014
2st FN of June	25.72	25.67	45.66	44.18	9552	9487	12379	12288
1nd FN of July	24.94	25.21	44.67	42.78	9348	9283	11135	10988
2st FN of July	24.17	24.73	41.67	40.15	7771	7706	11550	10396
SEm ±	0.73	0.45	0.85	0.71	318.94	318.94	402.97	450.33
CD (0.05)	NS	NS	3.55	2.80	1252.31	1252.30	1582.27	1068.72
C V %	8.72	5.38	5.82	5.10	10.76	10.84	10.65	12.03
Sub-plots: N Levels (B)								
100 % RDN	24.21	24.67	41.22	39.72	9477	9292	8140.00	8075.00
150 % RDN	24.90	25.31	44.89	43.06	12385	12179	9135.11	9070.11
200 % RDN	24.72	25.63	45.89	44.33	12202	12112	9396.22	9331.22
SEm ±	0.83	0.49	1.32	1.16	365.21	385.47	261.29	261.29
CD (0.05)	NS	NS	4.10	3.57	1125.33	1187.73	805.11	805.10
C V %	9.94	5.90	9.00	8.21	9.65	10.30	8.82	8.88
Interaction	NS	NS	NS	NS	NS	NS	NS	NS

four N levels as sub-sub plot treatments viz., 0, 50 %, 75 % and 100 % RDN to succeeding chickpea. All treatments are randomly allocated in three replications and split plot design for *kharif* season and double split designs for *rabi* crop was adopted for both years of the study. Each main plot (18x12m^2) divided in required size of three sub plots (6x12m^2) and each sub-plot (6x3 m^2) again divided in to four sub-sub plots. Accordingly the treatments were imposed randomly. Recommended dose of N for maize was applied in three splits ($^1/_2$ at sowing, ¼ at knee high stage and ¼ at tasseling stage, respectively) to preceding maize and entire dose at the time sowing to succeeding chickpea. The most popular and non lodging medium duration maize variety ie., P-3396 and popular desi chickpea JG-11 were used in both the year the study. The data pertaining to soil, weather and yield attributes and yield was collected during crop growth period. Statistical analysis for growth and yield parameters were done following the analysis of variance technique for split and double split design respectively as suggested by Gomez and Gomez (1984). Statistical significance was tested by applying F-test at 0.05 level of probability and critical difference (CD) were calculated for those parameters.

RESULTS AND DISCUSSION

Effect of sowing windows and N levels on maize

Sowing windows differed significantly with regard to test weight, HI, grain and stover yield of maize during both the years of study. Among the different sowing windows (Table 1) the highest test weight, harvest index, grain and stover yield were significantly recorded with the first sowing window (2nd FN of June) during the first and second years of study, respectively, and was significantly superior over 2nd FN of July sowing and was on a par with the 1st FN of July sowing during the first and second years of the study. The increased test weight, harvest index, grain and stover yield in first sowing window might be due to the cumulative effect of substantial improvement in growth characters. Efficient metabolic activity due to better soils and environmental factors in the first sowing window resulted in translation of photosynthates to kernels in higher kernel weight and yield. smilar results were reported by the earlier workers like Iqbaltak et *al*. (2010) and More *et al*. (2014).

There was an increase in harvest index, grain and stover yield with increase in nitrogen levels from 100 % to 200 % RDN during both the years of the study respectively. Significantly the highest harvest index, grain yield and stover yield were

Table 2. Test weight, harvest index, grain and stover yield of chickpea in maize-chickpea sequence at sowing windows and N levels.

Treatments							Yield (kg ha^{-1})	
Main Plots:	Test weight (g)		Harvest index (%)		Grain		Stover	
Maize sowing window (A)	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15
2st FN of June	240.32	233.72	39.00	37.54	1335	1325	1339	1917
1nd FN of July	244.61	249.77	39.81	37.61	1743	1742	2951	2908
2st FN of July	243.75	242.64	37.73	37.21	1550	1539	2720	2651
SEm ±	1.35	1.99	0.67	0.59	8.99	12.20	38.99	72.99
CD (0.05)	NS	NS	NS	NS	27.55	33.52	118.12	219.65
CV (%)	3.08	3.34	10.42	18.46	2.72	3.34	7.12	13.47
Sub-Plots: Nitrogen Levels (B) applied to maize								
100% RDN	241.64	235.25	38.07	36.78	1405	1399	1951	1930
150% RDN	242.25	243.19	38.30	37.79	1477	1472	2378	2363
200% RDN	245.00	247.69	40.18	37.87	1749	1735	3281	3183
SEm ±	1.74	2.68	0.77	0.87	12.53	24.99	2155	51.32
CD (0.05)	NS	NS	NS	NS	37.90	76.47	64.61	154.12
CV (%)	4.27	9.70	11.95	11.39	4.80	9.70	4.96	12.04
Sub-Sub plots: Nitrogen Levels (C) applied to chickpea								
0 % RDN	241.77	231.80	38.11	35.93	1224	1220	2220	2203
50 % RDN	244.81	239.84	38.20	37.44	1462	1448	2496	2445
75 % RDN	243.37	246.17	38.98	37.80	1637	1629	2665	2650
100 % RDN	241.89	250.36	40.09	38.74	1852	1845	2765	2669
SEm ±	2.69	3.13	0.79	1.10	16.59	27.39	21.99	63.64
CD (0.05)	NS	NS	NS	NS	49.80	82.20	66.61	191.22
CV (%)	5.73	9.81	10.66	17.59	5.90	9.81	4.81	19.98
Interactions								
AxB	NS	NS	NS	NS	NS	NS	NS	NS
AxC	NS	NS	NS	NS	NS	NS	NS	NS
BxC	NS	NS	NS	NS	NS	NS	NS	NS
AxBxC	NS	NS	NS	NS	NS	NS	NS	NS

recarded by the application of 200 % RDN which was significantly superior over 100 % RDN but on par with 150 % RDN. (Table.1). However, test weight and the interaction between sowing window and N levels was found non significant during both the years of the study. The beneficial role of nitrogen in enhancing the test weight, harvest index, grain and stover yield were reported by earlier workers like Bharathi (2010) and Vaisakhi *et al*. (2013).

Effect of sowing windows and N levels on chickpea

Test weight and harvest index could not be influence either by the preceding maize treatments nor by the succeeding chickpea treatments but grain and stover yield significantly influenced by sowing windows and N levels during both the years of the study. None of the interaction were significant.

Significantly more grain and stover yield of chickpea were obtaoned when the preceding maize was sown in the 1st FN of July with 200 % RDN followed by 100 % RDN to chickpea. Sowing maize in the first FN of July facilitated to harvest by October 2nd fortnight. Hence the succeeding chickpea was timely. The favourable climate at the time of sowing chickpea helped rapid germination, good crop stand with rapid growth of the succeeding chickpea. Applying 200 % RDN to preceding maize lead to residual available nitrogen and the nitrogen

doses applied to chickpea might have favoured the growth of chickpea taller plants resulting in more grain yield. Similar results were also reported by Iqbaltak *et al.* (2010), Alinamvar *et al.* (2013) and Rehman *et al* . (2015).

Conclusions

It can be concluded that sowing maize during 1st FN of July with 200 % RDN followed by 100 % RDN to succeeding chickpea was found to realize maximum yield in maize-chickpea sequence in Krishna zone of Andhra Pradesh.

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