E-ISSN: 2618-0618
P-ISSN: 2618-060X

www.agronomyjournals.com
2020; 3(1): 45-48
Received: 20-11-2019
Accepted: 25-12-2019

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Effect of de-topping and nitrogen levels on yield and nutrients uptake of maize (*Zea mays* L.)

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DOI: https://doi.org/10.33545/2618060X.2020.v3.i1a.31

Abstract
The experiment was conducted at Instructional cum research Farm, Indira Gandhi Agriculture University, Raipur (C.G.) during *Kharif* 2018 to study effect of de-topping and nitrogen levels on yield and nutrients uptake of maize (*Zea mays* L.) with two maize varieties (African tall and hybrid 25K55). The trial was conducted in split plot design with three replication in which de-topping and no de-topping were taken in main plot and four nitrogen levels in sub plot. The results of experiment maximum green fodder yield from de-topped portion (86.09 qha^{-1}) was observed in D_2N_4 de-topping in African tall along with 150 kg N ha^{-1}. Whereas the nutrient uptake was maximum in D_3N_4 Hybrid 25K55 with no-detopping in grains and maximum nutrient uptake in stover was obtained in D_1N_4 no de-topping in African tall with 150 kg N ha^{-1}. when practiced de-topping.

Keywords: topping, de-topping, nitrogen levels, productivity

Introduction
Maize (*Zea mays* L.) popularly known as corn or *makka* is one of the important cereal crops in world agriculture economy both as food for man and feed for animals. It has highest genetic potential among food grains crops. Among non-legumes fodders, maize is good source of starch, neutral detergent fibre (38-41%), acid detergent fibres (23-25%), lipid (5% oils), and crude-protein (8-10%) therefore considered as energy efficient crop for livestock. Grain maize area has increased from 93.4 thousand hectares (2000-01) to 119.63 thousand hectare in (2017-18) while production has gone up from 125.7 thousand tones to 306.1 thousand tones. There is 1.5 times increase in productivity. Maize used as green or preserved fodder (silage) for different categories of livestock. Forage maize content 27-31% cellulose and 20-24% hemicellulose and on dry matter basis when harvested to early dough stage. It is an important crop to develop standard agronomic practices to get maximum productivity. De-topping is such a cultural practice in which the apical or terminal portion of plant is removed from nodes above cobs *i.e*. leaving one or two leaves with aim to increase yield by controlling lodging, increasing light interception, increasing nutrient uptake, diverting plant nutrient to developing reproductive part (cobs) which in turn improves source to sink efficiency and resulting better cobs development.

Hence the present study was carried out with an objective to study the effect of de-topping and nitrogen levels on the quantity and quality of de-topped portion and nutrient uptake by maize (varieties).

Material Method
The experiment was conducted during *Kharif*, 2018 at Instructional cum Research farm, Indira Gandhi Agriculture University, Raipur (C.G.) with proper irrigation and drainage facilities. The soil was neutral in reaction pH (7.8) with electrical conductivity (EC) in the safer range (0.21 dSm^{-1}), low in organic carbon (0.58%) and available N (229.5 kg ha^{-1}) but medium in available phosphorus (16.3 kg ha^{-1}) and medium in potassium (272.02 kg ha^{-1}). A uniform dose of P_2O_5 (50 kg ha^{-1}) and K_2O (40 kg ha^{-1}) were applied in the form of chemical fertilizer, respectively and nitrogen was applied in three splits, 40% at basal, 30% at knee high stage and 30% at tasseling stage was scheduled. The experiment was laid out in split plot design with three replications and comprising sixteen treatment combinations with de-topping & no-detopping in maize varieties in main plots and four nitrogen levels 0, 50 kg, 100 kg, and 150kg N ha^{-1} in sub

Result and Discussion

Green Fodder Yield (q ha^{-1})

De-topping was done at 15 days after the 50% tasseling just above the cob emerged. The data related to green fodder yield (q ha^{-1}) is presented in Table 1. The maximum green fodder yield (86.09 q ha^{-1}) was recorded in fodder variety African tall with 150 kg N ha^{-1}. However the hybrid variety 25K55 recorded only (57.83 q ha^{-1}) green fodder yield with appliance of 150 kg N ha^{-1} which was 32 percent less as compare to the fodder variety African tall. Higher fodder yield in fodder variety African tall is due to the high growth and height of fodder variety African tall. The data shows that significantly higher green fodder yield of de-topped portion (71.84 q ha^{-1}) was obtained from African tall with de-topping. The results of present investigation are in line with the findings of Mimbra and Susylowati, (1995) [4], he reported that highest maize yield was obtained by topping 10 days after silk emergence.

Nitrogen appliance significantly influenced the green fodder yield. The highest green fodder yield (35.9 q ha^{-1}) was recorded with the application of 150 kg N ha^{-1} which was at par with plot receiving 100 kg N ha^{-1}, on the other hand lowest green fodder yield (18.6 q ha$^{-1)}$ was obtained in control plot.

Nutrients Uptake

Nitrogen Uptake (Kg ha^{-1})

The nitrogen uptake by grains and stover was significantly influence by de-topping. The highest nitrogen uptake in grain (42.01 kg ha^{-1}) was observed in hybrid 25K55 with no de-topping which was significantly superior, whereas lowest nitrogen uptake in grains (20.49 kg ha^{-1}) was observed in African tall with de-topping. Similarly, the influence of nitrogen levels was found significant, crop receiving 150 kg N ha^{-1} had significantly higher nitrogen content (46.12 kg ha^{-1}) in grains as compare to other doses of nitrogen.

However, the interaction effect of de-topping and nitrogen levels was found to be significant. The table 3 shows that highest nitrogen uptake (59.02kg ha^{-1}) was recorded under the treatment combination of hybrid 25K55 with no de-topping and application of 150kg N ha^{-1} which was superior over other treatment combinations tried in the experiment.

Table 1: Green fodder yield (q ha^{-1}) de-topped portion of maize varieties as influenced due to interaction effect of de-topping and nitrogen levels

Green fodder yield (q ha^{-1}) de-topped portion					
Main plot: DT & NO DT	**Sub plot**				
	N_1 : 0	**N_2 : 50**	**N_3 : 100**	**N_4 : 150**	**Mean**
Fodder type: African tall					
D_1: No De-topping	--	--	--	--	--
D_2: De-topping	47.65	72.64	80.97	86.09	71.84
Grain type: Hybrid 25K55					
D_3: No De-topping	--	--	--	--	--
D_4: De-topping	26.83	37.94	46.73	57.83	42.33
Mean	18.62	27.64	31.92	35.98	

Similarly nitrogen content in Stover was found maximum (192.4 kg ha^{-1}) in African tall with no de-topping followed by African tall with de- topping and lowest nitrogen content in stover was found in hybrid 25K55 with de-topping. The varied nitrogen levels significantly influenced nitrogen content in stover being the maximum nitrogen uptake (177.6 kg ha^{-1}) under treatment receiving 150 kg N ha^{-1} which was superior of other nitrogen levels. These results are in accordance with findings of Mishra *et al.* (2001) and Madhusudhan Reddy *et al.* (2010). However, the interaction of de-topping and nitrogen levels was found to be non- significant. Hence the total uptake of nitrogen by maize was higher (216.17 kgha^{-1}) in African tall with no de-topping followed by African tall with de- topping being the lowest in hybrid 25K55 with de- topping. Hence, it is clear that de-topping also had significant effect in total nitrogen uptake by the plant, as no de-topping plant recorded maximum nutrient uptake due to more herbaceous growth. Varied nitrogen levels also significantly influenced the total nitrogen uptake as the application of 150 kg N ha^{-1} recorded maximum total nitrogen uptake (206.50 kg ha^{-1}) which was highest among other nitrogen levels Table 3. However, the interaction effect was found non-significant.

Table 2: Nitrogen uptake (kg ha^{-1}) of maize varieties as influenced by de-topping and nitrogen levels.

Treatments	Grain	Stover	Total
Main plot: DT and No DT			
Fodder type: African tall			
D_1: No De -topping	24.77	192.43	216.17
D_2: De-topping	20.49	148.32	161.12
Grain type: Hybrid 25K55			
D_3: No De-topping	42.01	144.03	158.23
D_4: De-topping	37.18	107.42	119.68
S.Em ±	0.54	5.66	6
CD(P=0.05)	1.86	19.58	20.26
Sub plot: Nitrogen levels N (kg ha^{-1})			
N_1: 0	15.09	105.63	110.60
N_2: 50	24.82	147.96	160.11
N_3: 100	38.38	160.96	178.00
N_4: 150	46.16	177.64	206.50
S.Em±	0.69	5.47	7.26
CD(P=0.05)	2.02	15.96	21.20
Interaction DXN	S	NS	NS

Table 3: Nitrogen uptake (kg ha^{-1}) by grains of maize varieties as influenced due to interaction effect of de-topping and nitrogen levels.

Nitrogen uptake in grains					
Main plot: DT & No DT	**Sub plot**				
	N_1 : 0	**N_2 : 50**	**N_3 : 100**	**N_4 : 150**	**Mean**
Fodder type: African tall					
D_1: No De -topping	12.33	18.36	29.27	39.12	24.77
D_2: De-topping	9.87	14.86	24.87	32.37	20.49

Grain type: Hybrid 25K55					
D_3: No De-topping	20.69	35.59	52.72	59.02	42.01
D_4: De-topping	17.49	30.45	46.68	54.11	37.18
Mean	15.09	24.82	38.38	46.16	
Interaction				S.Em±	CD (P=0.05)
Comparison of two topping means at the same levels of nitrogen levels				1.38	4.04
Comparison of two nitrogen levels means at the same levels of topping				1.75	3.95

Phosphorus uptake (kg ha^{-1})

Phosphorus is one among the essential nutrient taken up by plants for better root development and grain fillings. The availability of phosphorus is not affected by variable nitrogen doses (Das 2017). It is clear that maximum phosphorus uptake in grain (10.4 kg ha^{-1}) was observed in hybrid 22K55 with no-de-topping which was significantly superior over other treatments followed by hybrid 25K55 with de- topping being the minimum under African tall with de- topping. Similarly it clear from the table crop receiving 150 kg N ha^{-1} maximum uptake of phosphorus *i.e.*,11.7 kg ha^{-1} followed by plot receiving 100 kg N ha^{-1} then plot with the application of 50 kg N ha^{-1}. It is clear that interaction effect was found to be significant. The maximum phosphorus uptake by grains (14.66 kg ha^{-1}) was observed under treatment hybrid 25K55 with no de- topping when coupled with application of 150 kg N ha^{-1} which was found at par with hybrid 25K55 with de-topping when coupled with 150 kg N ha^{-1} Table 7.

Table 6: Phosphorus uptake (kg ha^{-1}) of maize varieties as influenced by de-topping and nitrogen levels

Treatments	Grain	Stover	Total
Main plot: DT and No DT			
Fodder type: African tall			
D_1: No De-topping	6.17	21.77	27.94
D_2: De-topping	5.20	15.92	21.12
Grain type: Hybrid 25K55			
D_3: No De-topping	10.40	16.49	26.88
D_4: De-topping	9.70	13.50	23.20
S.Em ±	0.14	0.79	0.87
CD(P=0.05)	0.48	2.74	3.01
Sub plot: Nitrogen levels N (kg ha^{-1})			
N_1: 0	3.73	9.30	13.03
N_2: 50	6.27	16.20	22.48
N_3: 100	9.68	18.51	28.19
N_4: 150	11.78	23.67	35.45
S.Em ±	0.18	0.87	0.88
CD(P=0.05)	0.53	2.55	2.56
Interaction DXN	S	NS	NS

The data in the Table 6 revealed that the phosphorus uptake by stover was significantly maximum (21.77 kg ha^{-1}) under African tall with no de- topping followed by hybrid 25K55 with no de-topping being the lowest under hybrid 25K55 with de- topping. Different nitrogen levels also affected the phosphorus uptake by stover, as the application of 150 kg N ha^{-1} resulted in maximum phosphorus uptake by stover (23.67 kg ha^{-1}) followed by plot receiving 100 kg N ha^{-1} being the lowest under control plot. However, the interaction was found to be non-significant. The total uptake was found maximum (27.9 kg ha^{-1}) in African tall with no de-topping which was at par with hybrid 25K55 with no de-topping and minimum uptake was noticed in African tall with de-topping (21.8 kg ha^{-1}). The total uptake was found maximum with application of 150 kg N ha^{-1} (35.45 kg ha^{-1}) followed by application of 100 kg N ha^{-1} (28.14 kg ha^{-1}) then plot receiving 50 kg N.

Table 7: Phosphorus uptake (kg ha^{-1}) by grains of maize varieties as influence by de-topping and nitrogen levels.

Phosphorus uptake in grains					
Main plot: DT & No DT	**Sub plot**				
	N_1 : 0	**N_2 : 50**	**N_3 : 100**	**N_4 : 150**	**Mean**
Fodder type: African tall					
D_1: No De -topping	3.19	4.62	7.23	9.65	6.17
D_2: De-topping	2.52	3.67	6.20	8.39	5.20
Grain type: Hybrid 25K55					
D_3: No De-topping	5.11	9.00	12.81	14.66	10.40
D_4: De-topping	4.11	7.80	12.49	14.40	9.70
Mean	3.73	6.27	9.68	11.78	
Interaction				S.Em ±	CD (P=0.05)
Comparison of two topping means at the same levels of nitrogen levels				0.36	1.06
Comparison of two nitrogen levels means at the same levels of topping				0.46	1.04

Potassium uptake (kg ha^{-1})

Potassium uptake by grains is maximum (18.4 kg ha^{-1}) in hybrid 25K55 with no de- topping which was at par (17.15 kg ha^{-1}) with hybrid 25K55 with de-topping and lowest (8.7 kg ha^{-1}) in African tall with de-topping. Uptake of potassium in grains was significantly influence by different nitrogen levels being the

higher potassium uptake in grains (19.6 kg ha^{-1}) in plot receiving 150 kg N ha^{-1} which was superior among other treatments receiving different levels of nitrogen. However the interaction effect was non-significant.

Similarly uptake of potassium by stover was recorded significantly maximum (141.9 kg ha^{-1}) in African tall with de-topping which was at par with hybrid 25K55 with no de-topping followed by Africa tall with no de- topping. The potassium uptake was influenced by nitrogen levels significantly the maximum (178.7 kg ha^{-1}) potassium uptake by stover was recorded with treatment under application of 150 kg N ha^{-1} due to higher biomass production with this treatment as compared to other treatments. Interaction effect was found non-significant.

The total potassium uptake was noticed maximum (153.4 kg ha^{-1}) in hybrid 25K55 with no de-topping which was at par with Africa tall with de- topping, African tall with no de- topping and hybrid 25K55 with de- topping. Similarly the total potassium uptake was found maximum (198.4kg ha^{-1}) in plot receiving 150 kg N ha^{-1} which was significantly superior, followed by plot receiving 100 kg N ha^{-1} (172.3 kg ha^{-1}) and lowest total potassium uptake (77.9 kg ha^{-1}) was observed under unfertilized plot. However, the interaction effect was found to be non-significant.

Table 8: Potassium uptake (kg ha^{-1}) of maize varieties as influenced by de-topping and nitrogen levels

Treatments	Grain	Stover	Total
Main plot: DT and No DT			
Fodder type: African tall			
D_1: No De-topping	10.24	129.23	139.47
D_2: De-topping	8.76	141.90	150.67
Grain type: Hybrid 25K55			
D_3: No De-topping	18.43	135.03	153.46
D_4: De-topping	17.15	111.25	128.39
S.Em±	0.55	9.17	9.10
CD(P=0.05)	1.89	31.74	31.49
Sub plot: Nitrogen levels N (kg ha^{-1})			
N_1: 0	6.14	71.76	77.90
N_2: 50	11.12	111.98	123.10
N_3: 100	17.64	154.91	172.55
N_4: 150	19.67	178.75	198.43
S.Em±	0.36	6.69	6.68
CD(P=0.05)	1.05	19.54	19.50
Interaction DXN	NS	NS	NS

Conclusion

The findings on response of de-topping and nitrogen levels on the quantity and quality of de-topped portion and nutrient uptake by maize varieties, resulted that maximum green fodder yield from de-topped portion (86.09 qha^{-1}) was observed in de-topping in African tall along with 150 kg N ha^{-1}. Whereas the nutrient uptake was maximum in D_3N_4 Hybrid 25K55 with no-detopping in grains and maximum nutrient uptake in stover was obtained in D_1N_4 no de-topping in African tall with 150kg N ha^{-1}. When practiced de-topping.

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