

Original Research Article

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Effect of Detopping Practice on Growth Parameters and Yield of Rabi Maize (*Zea mays* L.)

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ABSTRACT

A field experiment was conducted at College of Agriculture, Professor Jayashankar Telangana State Agricultural University, Hyderabad, India, in rabi 2014-15 to study the effect of different stages and different heights of detopping on growth parameters and yield components of maize (DHM-117). The experiment was laid out in a randomized block design comprising of a factorial combination of three stages of detopping viz., D₁-10 days after silking, D₂-20 days after silking and D₃-30 days after silking and three heights of leaves detopping viz., L₁-detopping up to two leaves, L₂-detopping up to four leaves, L₃-detopping up to six leaves with a control and replicated thrice. The results revealed that, higher plant height, number of leaves, LAI, dry matter production and yield were recorded in control (no-detopping) than the treatments. However, detopping at different stages did not show significant effect on these parameters, but highest dry matter production and yield were observed with D₃ (detopping at 30 days after silking) and lowest in D₁ (detopping at 10 days after silking). In case of different heights of detopping more plant height, no. of leaves, LAI, dry matter and yield were observed in L₁ (detopping up to 2 top leaves) and lowest in L₃ (detopping up to 6 top leaves). SPAD readings were not affected by either different stage of detopping nor different heights. It was inferred that leaves which are adjacent to the cob (especially two above the cob) has more leaf area to produce more dry matter hence yield.

Keywords

Detopping, Yield, SPAD readings, Growth parameters, Maize, LAI.

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Introduction

Maize (*Zea mays* L.) is the 3rd most important cereal, next to wheat and rice in the world in respect to area and productivity. The worldwide area of maize about 177 million hectares and production of 989 million tonnes with a productivity of 5.5 t ha⁻¹ (2013-14) accounts about 64% of coarse grain and 27.1% of total cereal production (Commodity profile on maize, 2014). At present maize is being used to prepare more than 3000

different consumable products worldwide. In India 55% of grain produced currently is used for food purpose, about 14% for livestock feed, 18% for poultry feed, 12% for starch and 1% for seed. The expected demand for indigenous consumption and in international market is quite high. Therefore, level of production has to be substantially raised to meet its growing demand for food, feed and fuel. Being a C₄-plant it has best

physiological efficiency and highest productivity potential among the cereals. This crop is known to be very responsive to inputs (fertilizer, seed, water and macro or micro-nutrients etc.) and better crop management. Another category of farmers who grow maize for seed production purpose are practicing detopping in order to facilitate the pollen to reach silk directly.

Another group of farmers are also practicing detopping in maize to avoid lodging problem in fertile soils and especially in areas like coastal districts. Detopping refers to nipping or the removal of terminal portion from the uppermost node to improve the yield through greater functioning of remaining leaves by arresting unnecessary growth, decreasing mutual shading of leaves, enhancing light interception, increasing nutrient uptake, decreasing competition between the tassel and cob for available plant nutrients, diverting plant nutrients to the reproductive part which aids in better source-sink relationship and better cob development (Esechie and Al-Alawi, 2002).

Maize tassel removal may affect light penetration in the canopy, especially if the crop is a C_4 plant needs high light requirement. Tassel removal may increase the seed yield and seed quality. Interaction of defoliation and tassel removal may also affect assimilate distribution between reproductive and vegetative organs.

Hence the present study was carried out with an objective of to study the effect of different stages and heights of detopping on growth parameters in relation to yield in maize hybrid DHM117.

Materials and Methods

The present investigation was carried out at College Farm, College of Agriculture,

Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad during *rabi*, 2014-15. The farm is geographically situated at an altitude of 542.3 m above mean sea level at $17^{\circ}19'N$ latitude and $78^{\circ}28'E$ longitude and falls under the Southern Telangana Agro-Climatic Zone of Telangana state. The experiment was laid out in randomized block design with factorial concept in three replications. Treatments comprised of three stages of detopping at different days after silking and three heights of leaves detopping with single control (no detopping). The details of treatments are furnished below. Factor I: Days after Silking: D₁- 10 days after silking, D₂- 20 days after silking, D₃- 30 days after silking. Factor II: Detopping: L₁- detopping up to two leaves, L₂- detopping up to four leaves, L₃- detopping up to six leaves and Control (No detopping). Maize seeds (DHM-117) were planted in the field with plot size of 5.4 m x 4.8 m with spacing 60 cm x 20 cm on ridges at 19th Oct, 2014. The soil texture was sandy loamy with pH 7.5, EC 0.163 dSm⁻¹ and organic carbon 0.40%. The soil was low in available nitrogen (175 kg ha⁻¹), medium in available phosphorus (36 kg ha⁻¹) and high in available potassium (342 kg ha⁻¹). For all treatments fertilizer was applied on the basis of recommended dose of N: P: K was 200:80:80 kg ha⁻¹. The silking came at 60 DAS and treatments were implemented at 10 days interval. Herbicide and pesticide were used to control the weeds and pests. Every 10-12 days interval, irrigation has given based on soil moisture content. Crop was harvested at 15th Feb 2015. Growth parameters such as non-destructive sampling parameters like plant height, number of leaves and SPAD were recorded from five plants were selected randomly and tagged in each treatment plot. Similarly, at each sampling interval five plants for destructive sampling (LAI, Dry matter) were uprooted from two rows on either side between border and net plots

earmarked for the purpose. Yield has taken from net plot and converted into kg ha⁻¹.

Results and Discussion

Plant height (cm)

The results (Table 1) revealed that different stages of detopping didn't show significant influence on plant height. But different heights of detopping had significant influence on plant height. Maximum plant height (192.9 cm) was recorded in L₁ (Detopping upto top 2 to leaves) and significantly superior to L₂, and L₃ (Detopping up to top 4 and 6 leaves respectively), in turn these are significantly differ with each other and L₃ recorded the lowest plant height (150.6 cm). The decrease in plant height might be due to the termination of apical dominance (Brar *et al.*, 2000). These results are in accordance with the findings of Tadesse *et al.*, (2012), Usman *et al.*, (2007), Firoz *et al.*, (2010), Hallikeri *et al.*, (2010) and Srisailam (2010). The interaction effect of different stages and heights of detopping on plant height was not found significant at any stage of the crop growth. In comparison of control vs. treatments, highest plant height was registered in control (215.2 cm) and significantly superior to all other treatment combinations.

Number of leaves

Experimental data on number of leaves influenced by effect of different stages and heights of detopping was presented in table 1. During the period of investigation, different stages of detopping did not exert significant influence on number of leaves. Reduction in number of leaves is due to removal of tops and gradual senescence of older leaves. Different heights of detopping had significant on effect of number of leaves. Higher number of leaves (12.1) were obtained from L₁ (detopping up to 2 tops removal) over L₂ and L₃ (detopping up to 4 & 6 top leaves

removal). Whereas, less number of leaves (8.5) were obtained from L₃ (detopping up to 6 top leaves removal) at 90 DAS and at harvest. The result of present investigation regarding different heights of detopping was in line with Wilhelm *et al.*, (1995) who reported that the average number of leaves remaining above ear after treatment application ranged from 5.4 for control to 1.4 for tassel + 4 leaves removal and declined linearly with the number of leaves removed. The interaction effect of different stages and heights of detopping on number of leaves was not found significant. In comparison of control vs. treatments, control (no detopping) recorded significantly more number of leaves (15.5) over other treatments.

Leaf Area Index (LAI)

Experimental data on LAI influenced by effect of different stages and heights of detopping was presented in table 1. Different stages of detopping on LAI were not found significant. Detopping at different heights showed significant influence on LAI. At harvest maximum LAI (4.16) was observed with L₁ (detopping up to 2 top leaves) and was significantly superior over L₂ and L₃ (Detopping up to top 2, 4, and 6 leaves, respectively), whereas, L₃ recorded lowest LAI (2.85). Removing of leaves either 3 or 4 had a greater impact on LAI than removal of 1 and 2 leaves because of the difference in size of leaves; leaves nearest ear were larger than those further from the ear (Dwayer and Stewart, 1986; Keating and Wafula, 1992). Effects of leaf removing on LAI were different according to the intensity of defoliation and leaf position (Barimavandi *et al.*, 2010). The results were in conformity with the findings of Wilhelm *et al.*, (1995), Saihkouhian (2012) and Esechie and AL-Alawi (2002). The interaction effect of different stages and heights of detopping on leaf area index was not found significant at all stage of the crop growth. In comparison of

control vs. treatments, more LAI (4.70) was obtained from control (no detopping) and which was significantly superior over other treatments. Decrease in LAI by 11.4%, 28.9% and 39% with L₁ (detopping up to 2 top leaves), L₂ (detopping up to 4 top leaves) and L₃ (detopping up to 6 top leaves), respectively when compared to control (no detopping).

SPAD chlorophyll meter readings

Experimental data on SPAD chlorophyll meter readings was analyzed statistically and presented in table 1. The effect of different stages of detopping and different heights of detopping on SPAD chlorophyll meter readings was not found significant. The results were in accordance with findings Bijanzadeh and Emam (2010) who reported that flag leaf chlorophyll content was not affected by source restriction. During the period of investigation, interaction effect of different stages and heights of detopping and in comparison of control vs. treatments did not exert significant influence on chlorophyll content.

Dry matter production (g m⁻²)

Data pertaining to effect of different stages and heights of detopping on dry matter (DM) production was analyzed statistically (Table 2) and found to vary significantly. Different stages of detopping had more effect on dry matter. Significantly more dry matter (1641 g m⁻²) was observed in D₃ (detopping at 30 days after silking) at harvest over D₁ (detopping at 10 days after silking). However D₂ (detopping at 20 days after silking) was found to be on par with D₃, whereas, D₁ recorded the lowest dry matter at this stage (1440 g m⁻²). The reason for decreasing in dry matter with D₁ (detopping at 10 days after silking) might be due to early reproductive phase was more sensitive to source restriction, any stress causes at this stage has negative impact on dry matter production and also yield

compared to later stages. Barimavandi *et al.*, (2010) found that 92 DAS, dry matter increasing found descent lane under defoliating two leaves on the top of ear. Different types of leaf clipping have various influences on dry matter accumulation when leaf clipping occurs at the primary stage of grain development (Wang, 1996). Among different heights of detopping, significantly higher dry matter (1588 g m⁻²) was found to be associated to L₁ (detopping up to 2 top leaves) at harvest, and which was statistically at par with L₂ (detopping up to 4 top leaves removal). Whereas, least (1538 g m⁻²) amount belonged to L₃ (detopping up to 6 top leaves) at harvest. Even though LAI reduced with number of leaf removal, but dry matter production was not affected or slightly affected by detopping up to 2 and 4 top leaves, whereas more reduction in dry matter was observed with detopping up to 6 top leaves (L₃).

This reduction in DM might be due to loss of photosynthetic area in L₃ (detopping up to 6 top leaves) because no leaves above the cob when plant was detopped up to 6 top leaves. These results are in conformity with findings of Barimavandi *et al.*, (2010) who found that 92 DAS, dry matter increasing found descent lane under defoliating two leaves on the top of ear. Probable reason for this incident is suitable position of upper leaves for perfect absorption of sun light and superior photosynthesis. Another reason for this stem is an important secondary resource in maize and this act efficiently under stress condition.

The amount of retransmission of stored assimilates from stem to grain depends on intensity of defoliation and position of leaves. So that the removing above leaves causes exceed retransmission of assimilates to grain. Consequently, removing of these leaves is lead to decrease in photosynthetic materials and little production of dry matter.

Table.1 Plant height, no. of leaves, leaf area index and SPAD meter readings of maize as influenced by different stages and Heights of detopping

Treatment	Plant height (cm)				Number of leaves				Leaf area index				SPAD meter readings			
	L ₁	L ₂	L ₃	Mean	L ₁	L ₂	L ₃	Mean	L ₁	L ₂	L ₃	Mean	L ₁	L ₂	L ₃	Mean
D ₁	194.7	161.9	152.0	169.5	12.5	10.1	8.6	10.4	4.17	3.37	2.88	3.47	52.63	56.03	52.66	53.77
D ₂	193.9	164.0	153.5	171.1	11.8	10.3	8.7	10.3	4.14	3.32	2.85	3.43	55.90	54.40	51.30	53.86
D ₃	190.0	164.7	146.4	165.9	12.0	11.2	8.3	10.5	4.16	3.32	2.82	3.43	49.90	53.03	50.93	51.28
Mean	192.9	163.5	150.6		12.1	10.5	8.5		4.16	3.34	2.85		52.48	54.48	51.63	
Control	215.2				15.5				4.70				52.93			
	SEm±	CD (P=0.05)			SEm±	CD (P=0.05)			SEm±	CD (P=0.05)			SEm±	CD (P=0.05)		
Factor (I)	1.56	NS			0.18	NS			0.02	NS			1.31	NS		
Factor (II)	1.35	2.85			0.16	0.35			0.02	0.04			1.31	NS		
Interaction	2.70	NS			0.31	NS			0.04	NS			2.27	NS		
Control vs. Treatment	3.31	9.89			0.38	1.23			0.05	0.15			2.78	NS		

Factor (I): Different stages of detopping: D₁- 10 days after silking, D₂- 20 days after silking and D₃- 30 days after silking

Factor (II): Different heights of detopping: L₁- Detopping up to 2 top leaves, L₂- Detopping up to 4 top leaves, L₃- Detopping up to 6 top leaves

Control- No detopping

Table.2 Dry matter production and grain yield of maize as influenced by different stages and heights of detopping

Treatment	Dry matter (g m ⁻²)				Grain yield (kg ha ⁻¹)			
	L ₁	L ₂	L ₃	Mean	L ₁	L ₂	L ₃	Mean
D ₁	1484	1469	1368	1440	5288	5238	4168	4898
D ₂	1639	1636	1607	1627	7197	7195	6872	7088
D ₃	1642	1639	1641	1641	7218	7198	7196	7204
Mean	1588	1581	1538		6568	6544	6078	
Control	1653				7226			
	SEm±	CD (P=0.05)			SEm±	CD (P=0.05)		
Factor (I)	6.67	14.02			55.9	117.6		
Factor (II)	5.78	12.14			48.4	101.8		
Interaction	11.56	24.28			96.9	203.7		
Control vs. Treatment	14.15	42.05			118.7	352.9		

Factor (I): Different stages of detopping: D₁- 10 days after silking, D₂- 20 days after silking and D₃- 30 days after silking

Factor (II): Different heights of detopping: L₁- Detopping up to 2 top leaves, L₂- Detopping up to 4 top leaves, L₃- Detopping up to 6 top leaves

Control- No detopping

The reason of declining in the amount of dry matter in plant might be due to elimination of young leaves at anthesis stage which leads to diminished amounts of dry matters accumulation in plant. Removing of these leaves have intensive effect on dry weight in diminishing order. The present experimental findings are in accordance with the results of Jalilian and Delkoshi (2014), safari *et al.*, (2013) and Tilahun (1993). The results of interaction effect of different stages and heights of detopping showed that maximum dry matter was obtained from detopping at 30 days after silking (D₃) up to 2 top leaves (L₂) and it was on par with removal of 4 (L₂), 6 (L₃) top leaves detopping at 30 days after silking. And which was statistically at par with detopping up to 2, 4 top leaves+ at 20 days after silking (D₂). In turn minimum dry matter occurred in detopping at 10 days after silking (D₁) with removal of 6 top leaves (L₁). When compared control vs. treatments, control (no detopping) recorded higher dry matter (1653 g m⁻²) at harvest and which was statistically similar with detopping at 30 days after silking (D₃) with removal of 2 (L₁), 4 (L₂), and 6 (L₃) top leaves and detopping at 20 days after silking (D₂) with removal of 2 and 4 top leaves. Reduction in dry matter in D₁ might be due to defoliation treatments imposed when the number of grains had been established reduced the source/sink ratio and resulted in a sharp decrease in stem soluble carbohydrates (Wesgate and Boyer, 1985). The above experimental finding was in accordance with the results of Woldeamlak *et al.*, (2006).

Grain yield (kg ha⁻¹)

Experimental data on grain yield was presented in table 2. The difference in grain yield of maize was conspicuous with different stages of detopping. The highest grain yield (7204 kg ha⁻¹) was obtained with D₃ (detopping at 30 days after silking) and which

was comparable with D₂ (detopping at 20 days after silking), and both the treatments were found to be significantly superior over D₁ (detopping at 10 days after silking). Lowest was recorded in D₁ (4898 kg ha⁻¹). The above experimental findings indicated that delay in detopping was associated with increased trend in grain yield. Reduction of yield as a sequence of leaf removal from maize plant when they were in early reproduction phase has been reported by many researchers (Afarinesh, 2005 and Borrás and Otegui, 2001). Topping at two weeks after anthesis did not have any adverse effect on grain yield (Sarvestani *et al.*, 2001). These results were in conformity with Emam *et al.*, (2013), Woldeamlak *et al.*, (2006), Mimer and Susyelowati (1995). Among different heights of detopping, significantly higher grain yield (6568 kg ha⁻¹) was obtained in L₁ (detopping up to 2 top leaves) and was found to be par with L₂ (detopping up to 4 top leaves), in turn L₃ (detopping up to 6 top leaves) recorded the lowest grain yield (6078 kg ha⁻¹). The results of present study showed that reduction in grain yield as removal of number of leaves above the cob increased. There is a direct relationship between grain yield and the number of leaves removed (Tilahun, 1993). In any crop, the degree of yield reduction is directly proportional to the percentage of leaf area destroyed. The loss of functional leaf area results in loss of photosynthetic area of plant and reduce the assimilate availability (Walpole and Morgan, 1970). The superior effect of top leaves on the yield depends on their extent of sunlight absorption. It was reported that apex leaves of ear could transfer about 23-91% of photosynthetic matters to the cobs. (Anderew and Peterson, 1984). The grain stores photosynthates via three main resources including current photosynthesis in the leaves, photosynthesis in green parts of plants excluding leaves and transferring from the storing parts (Hashemi and Maraashi, 1993).

The findings are in accordance with those of Barimavandi *et al.*, (2010), Jalilian and Delkhoshi (2014), safari *et al.*, (2013). Interaction effect of different stages and heights of detopping showed that significantly higher grain yield (7218 kg ha^{-1}) was recorded in 30 days after silking (D_3) and detopping up to 2 to leaves (L_1) and was on par with detopping up to 4 (L_2), 6 (L_3) top leaves and detopping at 20 days after silking (D_2) with detopping up to 2 and 4 top leaves. On the other hand D_1 (detopping at 10 days after silking) with 2, 4 and 6 top leaves removal recorded lowest grain yield (5288 kg ha^{-1} , 5238 kg ha^{-1} and 4168 kg ha^{-1} , respectively). In early stages of detopping up to 2, 4 and 6 top leaves grain yield reduced, but in later stages detopping up to 2, 4 top leaves did not altered the grain yield. However, when plants were detopped above the cob (L_3) drastically reduced the grain yield. These results were in conformity with Emam *et al.*, (2013), Mimbar and Susylowati (1995) and Subedi (1996). when compared with control vs. treatments, higher grain yield (7226 kg ha^{-1}) was recorded in control (no detopping), as compared to less grain yield noticed in detopping at 10 days after silking (D_1) with detopping up to 2, 4 and 6 top leaves and reduction of yield in percentages were 26.8%, 27.5% and 42.3% respectively. On other hand control produced significantly comparable grain yield with detopping at 30 days after silking with 2, 4 and 6 top leaves removal (reduction of yield in percentages were 0.1%, 0.3% and 0.4% respectively) and detopping at 20 days after silking with 2 and 4 top leaves removal (reduction yield in percentages were 0.4% and 0.42% respectively).

From this experiment it can be concluded that different stages and heights of detopping did not show significant interaction effect on plant height, leaf area index, number of leaves and SPAD readings. Higher dry matter production was observed at harvest with

detopping at 20 and 30 days after silking up to 2, 4 and 6 top leaves. In comparison of control vs. treatments, more plant height, number of leaves and LAI was noticed in control over other treatments. In case of dry matter production control was found to be statistically comparable with detopping at 30 days after silking up to 2, 4 and 6 top leaves and also with 20 days after silking up to 2 and 4 top leaves.

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