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SOWING DATES AND NITROGEN LEVEL EFFECT ON YIELD AND YIELD ATTRIBUTES OF SESAME CULTIVARS

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ABSTRACT

The performance of sesame cultivars (Sesamum indicum L.) was evaluated using various sowing dates and nitrogen levels at New Developmental Farm The University of Agriculture, Peshawar, Pakistan during summer 2012. The experiment was laid out in (RCBD) with split plot arrangement having four replications. Sowing dates (20th June, 10th and 30th July) and sesame cultivars (local black and local white) were allotted to main plots, while nitrogen levels (0, 40, 80 and 120 kg N ha^{-1}) were allotted to sub plots. Sowing dates had significantly affected all the parameters. Plants sown on 20th June had maximum capsules m^{-2} (1130), capsules plant^{-1} (102), seed capsule^{-1} (69), shelling percentage (67%), 1000 seed weight (3.78 g), seed yield (1135 kg ha^{-1}), stover yield (6318 kg ha^{-1}) and harvest index (15%) as compared with other sowing dates. The cultivar local black had more capsules plant^{-1} (71), seed capsule^{-1} (61), seed yield (696 kg ha^{-1}), stover yield (4297 kg ha^{-1}) and harvest index (14%) as compared to cultivar local white. Nitrogen application had also significantly affected all parameters. Plots treated with 120 kg N ha^{-1} produced maximum capsules m^{-2} (951), capsules plant^{-1} (86), seed capsule^{-1} (70), shelling percentage (70%), 1000 seed weight (4.08 g), seed yield (833 kg ha^{-1}), stover yield (5351 kg ha^{-1}) and harvest index (15%). The interaction between sowing dates, nitrogen level and sesame cultivars showed that crop sown on 20th June with local black cultivar and treated with 120 kg N ha^{-1} had maximum capsules plant^{-1} (128), seed capsule^{-1} (82), seed yield (1599 kg ha^{-1}) and stover yield (9223 kg ha^{-1}) but its harvest index was significantly lower than cultivar local white. Local black cultivar sown on 20th June treated with 120 kg N ha^{-1} seemed to be the best choice for sesame producer in the agro-ecological condition of Peshawar valley.

***Key words**:* **Sesame (Sesamum indicum L.), sowing dates, nitrogen level, sesame cultivars, stover yield, seed yield, yield components**

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INTRODUCTION

Sesame (*Sesamum indicum* L.) a member of the order tubiflera, family Pedaliaceae is a short-day plant. Sesame seed are small and ovate with two distinct types, cream-coloured and black. Cream-coloured seeds are preferred by the consumers (Qadeer, 1998). It is one of the most important oil crops grown in the tropical and subtropical areas of the world. Sesame is considered as a drought tolerant crop and is therefore mainly grown as dry land crop especially in Indian sub continent where crop sowing time is dependent upon the availability of moisture, therefore sowing is delayed. Sesame yield is highly variable depending upon the growing environment, cultural practices and cultivars used. Yield decreases as a result of late planting (late them optimum planting date) have been reported in the literature and this reduction could be due to increased incidence of the sesame webworm (*Antigastra catalaunalis* Dup), changes in photoperiodism of sesame (Alamsarkar *et al*., 2007). Rahman *et al*. (2007) reported that grain yield of cultivars were significantly influenced by sowing date and the interaction between sowing dates and cultivars were also highly significant. In India, sowing on 15th May, 15th June and 15th July attained grain yield of 325, 101 and 45 kg ha^{-1} respectively (Elmahdi *et al*., 2007).

Fertilizers are not applied to sesame even in major sesame growing areas of Nigeria (Shehu *et al*., 2010). However there are studies where positive effects of up to 150 kg N ha-1 have been reported (Kalaiselvan *et al*., 2001). Adequate supply of nitrogen is beneficial for both carbohydrates and protein metabolism as it promote cell division and cell enlargement, resulting in, more leaf area, crop growth rate, leaf area index and thus ensuring good seed and dry matter yield (Ahmad *et al*. 2001).Sesame is an important edible oilseed crop, however, its yield is very low (Average < 500 kg ha-1 in Pakistan (MINFA, 2009). The crop has wide variety of uses and there are well-developed domestic and international markets for its seed. Whole seed of sesame is used as food, cake, cookies and bread than eaten as confectionery. The seed contains all essential amino acids and fatty acids. It is a good source of vitamins (pantothenic acid and vitamin E) and minerals such as calcium (1450 mg 100 g-1) and phosphorous (570 mg 100 g-1) and the seed cake is also an important nutritious livestock feed (Malik *et al*., 2003). Keeping in view the limitations under rainfed condition this experiment was conducted at the irrigated condition under the intensive farming system. As sowing was not dependent on the rainfall therefore the crops was sown on different dates having various levels of N with aim to find out the optimum sowing date, nitrogen level and cultivar for higher yield at the agro-climatic condition of Peshawar.

MATERIALS AND METHODS

The experiment was conducted at New Developmental Farm The University of Agriculture, Peshawar (34^o 00' N, 71^o 30' E, 510 MASL) Pakistan during summer 2012. The experiment was carried out in RCBD with split plot arrangement having four replications. Sowing dates and sesame cultivars was allotted to main plots, while nitrogen levels were allotted to sub plots. The sub plot size was 2.4 m x 3 m. Each sub plot was consisted of 6 rows having 40 cm row-to-row distance. Half of N and whole P (60 kg ha^{-1}) was applied at the time of sowing and the remaining N was applied before flowering. Crop was sown at seed rate of 4 kg ha^{-1} and agronomic practices were carried out uniformly for all the experimental units throughout the growing season. Capsules m^{-2} in each sub plot was recorded by counting the number of capsules from one-meter row length at three places and then its average was calculated. Number of capsule plant^{-1} was counted in ten plants selected randomly in each sub plot and then its average was computed. Data on number of seed capsule^{-1} were recorded by counting seed in ten capsules selected randomly in each sub plot and then its average was taken. Shelling percentage was calculated by the following formula:

$$\text{Shelling (\%)} = \frac{\text{Grains weight of ten capsules}}{\text{Weight of ten capsules}} \times 100$$

After threshing capsules, the data on thousand seed weight (g) were recorded from three seed lots and weighted with the help of electronic balance. Four central rows in each sub plot were harvested, sun dried and threshed. Seed weight and stover yield was taken with an electronic balance and then converted into kg ha^{-1} by the following formula.

$$\text{Seed yield (kg ha}^{-1}\text{)} = \frac{\text{Grains weight in four rows (kg)}}{\text{No of rows x Row length x R-R distance}} \times 10{,}000 \text{ m}^2$$

Harvest index was calculated by using the following formula.

$$\text{Harvest Index (\%)} = \frac{\text{Grain yield (kg ha}^{-1}\text{)}}{\text{Biological yield (kg ha}^{-1}\text{)}} \times 100$$

Data collected were analyzed statistically according to the procedure relevant to RCB design. Upon significant F-Test, least significance difference (LSD) test was used for mean comparison to identify the significant components of the treatment means (Jan *et al*., 2009).

RESULTS AND DISCUSSION

Capsules m^{-2}

Mean values of capsules m^{-2} on various sowing dates indicated that crop sown on 20th June produced significantly highest (1130) capsules m^{-2} while significantly lowest (489) capsules m^{-2} were obtained when crop was sown on 30th July (Table 1). These results are in conformity with the findings of Rahman *et al*. (2007) and Alamsarkar *et al*. (2007) who also recorded higher capsules m^{-2} in early sowing mid June as compared to late sowing mid July in Northern Sudan. Plots treated with 120 kg N ha^{-1} produced significantly highest (951) capsules m^{-2} while significantly lowest (501) capsules m^{-2} were recoded in control plots. This might be due to the less amount of nitrogen available in control plots and therefore had less number of capsules m^{-2} produced. These results are in line with Malik *et al*. (2003) and Shehu *et al*. (2010) who observed that capsules m^{-2} increased with increasing nitrogen level up to 90 kg N ha^{1}.

Number of capsules plant^{-1}

Data on number of capsule plant^{-1} is presented in (Table 1). Mean number of capsule plant^{-1} at different planting dates indicated that significantly highest (102) number were produced when crop was planted on 20th June while significantly lowest (44) number of capsules plant^{-1} were recorded when crop sown on 30th July. The possible reason could be that early planted crop which had prolonged photoperiod (almost 40 days) utilized more assimilates in producing of capsules as compared to late sown crop. These results are in conformity with the findings of Rahman *et* *al*. (2007) and Alamsarkar *et al*. (2007) who recorded higher (46) number of capsules plants^{-1} in early sowing mid June as compared to late sowing July. Plots treated with 120 kg N ha^{-1} produced significantly highest (86) number of capsules plant^{-1} while significantly lowest (47) number of capsules plant^{-1} was recorded in control plots. These results are in line with Malik *et al*. (2003), Sharar *et al*. (2000) and Shehu *et al*. (2010) who reported that capsules plant^{-1} increased with increasing N levels. Cultivar local white produced significantly highest (71) number of capsules plant^{-1} as compared to local black cultivar (67). This must be due to difference in genetic constitution of sesame cultivars. Interaction among D x V x N indicated in (Fig. 1) that both cultivars produced maximum number of capsules plant^{-1} when sown on 20th June. Number of capsules plant^{-1} increased with increasing nitrogen levels. Early sown crop had maximum number of capsules plant^{-1} even when nitrogen was not added as compared with other sowing dates.

Number of seeds capsule^{-1}

The data on seeds capsule^{-1} (Table 1) indicated that crop sown on 20th June produced significantly highest (69) number of seeds capsule^{-1}. Significantly lowest (55) number of seeds capsule^{-1} were recorded when crop was sown on 10th July but this value was not significantly different than the one on 30th July. The reason for higher seeds in early planting could be the effect of prolonged photoperiod which might have resulted in more assimilates in capsules resulting in larger number of seeds capsule^{-1}. Similar results were reported by Alamsarkar *et al*. (2007) who recorded higher (57) number of seeds capsule^{-1} in early sowing as compared to late sowing. Plots treated with 120 kg N ha^{-1} produced significantly highest (70) number of seeds capsule^{-1} while significantly lowest (47) number of seeds capsule^{-1} was produced in control plots. This may be due to the increase in nitrogen content in plants resulting in more vegetative and reproductive growth as result of better partitioning of assimilates towards reproductive units such as seeds capsule^{-1} increase with increase nitrogen levels. Similar results were reported by Malik *et al*. (2003), Sharar *et al*. (2000) and Shehu *et al*. (2010). In their research they observed that seeds capsule^{-1} increased with an increase in nitrogen level up to 80 kg ha^{-1}. Cultivar local black produced significantly highest (61) number of seeds capsule^{-1} as compared to local white cultivar which produced significantly lowest (59) number of seeds capsule^{-1}. Interaction among D x V x N shows in (Fig. 3) indicated that both cultivars produced maximum number of seeds capsule^{-1} when sown on 20th June. Number of seeds capsule^{-1} increased with increasing nitrogen levels. Early sown crop had maximum number of seeds capsule^{-1} even when nitrogen was not added as compared with other sowing dates

Shelling (%)

Mean values of data indicated that maximum (67 %) shelling was produced when crop was sown on 20th June while minimum (63 %) shelling were recorded when crop sown both 10th and 30th July. Similar results were reported by Alamsarkar *et al*. (2007) who recorded maximum shelling (61 %) when sown early while delay sowing the shelling % drastically decrease. Plots that were treated 120 kg N ha^{-1} produced maximum (70%) shelling while minimum (58%) shelling was recorded in control plots. Similar results were reported by Malik *et al*. (2003), Sharar *et al*. (2000) and Shehu *et al*. (2010) who reported that shelling (71 %) increased with increasing nitrogen level up to 150 kg ha^{-1} if we compared to control plots. The interaction between N x V shows in (Fig. 2) that increase shelling % with increase in nitrogen level was recorded for both cultivars local black and white. Local black initially responded well at low nitrogen level but at higher level of nitrogen beyond 40 kg ha^{-1} identical shelling (%) was recorded for both cultivars.

Thousand seeds weight (g)

Mean values of sowing dates indicated that crop sown on 20th June produced heavier (3.78 g) seed weight while minimum (2.89 g) seed weight was obtained when crop sown on 30th July. Earlier sown crop gained prolonged growth period with ideal growth condition as result heavier grains were produced as compared to late sown. Similar notations were reported by Rahman *et al*. (2007), Alamsarkar *et al*. (2007) who reported that early sowing significantly improved seed weight as compared to late sowing. Plots treated with 120 kg N ha^{-1} produced heavier (4.08 g) seed weight, followed by 80 kg N ha^{-1} produced (3.56 g) seed weight while minimum seed weight (2.72 g) was recoded in control plots. The reason could be that nitrogen level extended vegetative growth as result maturity is delay and grain-filling duration was extended and therefore heavier grains were produced. These results are in line with those of Malik *et al*. (2003), Umar *et al*. (2012) Sharar *et al*. (2000) and Shehu *et al*. (2010) who reported that Increasing rate of nitrogen application significantly increased the mean seed weight. Interaction between D x N indicated in (Fig. 4) that crop planted on 20th June and treated with 120 kg N ha^{-1} produced heavier seed weight (4.75 g) while minimum (2.57 g) seed weight were recorded in control plots sown on 30th July.

Stover yield (kg ha^{-1})

Mean value of sowing dates show that stover yield significantly reduced with delay in sowing. Plots sown on 20th June had significantly higher stover yield (6318 kg ha^{-1}) while lowest stover yield (2087 kg ha^{-1}) was recorded for 30th July sowing. These results are in line with those Alamsarkar *et al*. (2007) who reported that early June sowing had significant effect on stover yield when we compared to late sowing. The effect of nitrogen was significant on stover yield. With increase of nitrogen level stover yield increase significantly and therefore the highest level of nitrogen (120 kg ha^{-1}) produced maximum stover yield (5351 kg ha^{-1}) while lowest yield is recorded in control plot (2562 kg ha^{-1}). Nitrogen fertilizer delay physiological maturity due to extend the vegetative period of the crop and plant attained maximum branches plant^{-1} and plant height thus increase stover yield. These results are in line with the findings of Shehu *et al*. (2010) who reported that significantly increase in stover yield occur with increase in nitrogen level. Cultivar local black produced maximum (4297 kg ha^{-1}) stover yield as compared to local white cultivar produced (3706 kg ha^{-1}) stover yield. It may be due to their genetic as well as phenotypic difference form local white cultivar. The interaction among D x V x N shows in (Fig. 5) indicated that both cultivars produced maximum stover yield when sown on 20th June. Stover yields increased with increasing nitrogen levels. Early sown crop had maximum stover yield even when nitrogen was not added as compared with other sowing dates.

Seed yield (kg ha^{-1})

Data regarding seed yield is presented in (Table 1). Mean value of sowing dates indicated that seed yield significantly reduced with delay in sowing. Plots sown on 20th June had significantly maximum seed yield (1135 kg ha^{-1}) while minimum seed yield of (306 kg ha^{-1}) was recorded when crop sown on 30th July. Early sowing had longer growth period as a result more seed yield was produced as compared to late sown these finding are in line with those of Rahman *et al*. (2007) and Alamsarkar *et al*. (2007). Plots supplied with nitrogen had significantly higher seed yield as compared to control plots. With increase of nitrogen level seed yield increase significantly and therefore the highest level of nitrogen (120 kg ha^{-1}) produced maximum seed yield (833 kg ha^{-1}) while minimum (339 kg ha^{-1}) seed yield was recorded in control plot. These results confirm the findings of Ali and Ahmed (2012) and Shehu *et al*. (2010) who reported that increasing rate of nitrogen application significantly and linearly enhanced seed yield as compared to control plots. Cultivar local black produced maximum (696 kg ha^{-1}) seed yield as compared to cultivar local white produced minimum (554 kg ha^{-1}) seed yield. Interaction among D x V x N shows in (Fig. 6) that both cultivars produced maximum seed yield when crop sown on 20th June. Seed yield increased with increasing nitrogen levels. Early sown crop had maximum seed yield even when nitrogen was not added as compared with other sowing dates. Crop sown on 20th June with cultivar local black and treated with 120 kg N ha^{-1} produced maximum (1599 kg ha^{-1}) seed yield.

Harvest index (%)

Mean value of sowing dates indicated that harvest index significantly reduced with delay in sowing. Plots sown on 20th June had significantly highest (15 %) harvest index while significantly lowest (11 %) harvest index was recorded for 30th July sowing. These results are in line with those Alamsarkar *et al*. (2007) who reported that early sowing had significant effect on harvest index as compared to late sowing. Plots supplied with nitrogen had significantly higher harvest index as compared to control plots. With increase of nitrogen level harvest index increase significantly and therefore the highest level of nitrogen (120 kg ha^{-1}) produced maximum harvest index (15 %) while lowest (10%) harvest index was recorded in control plots. These results are in line with the findings of Shehu *et al*. (2010) who reported that increasing rate of nitrogen application significantly increased harvest index over other rates of application as well as control plots. Cultivar local black recorded maximum (14 %) harvest index as compared to cultivar local white produced (12 %) harvest index. It may be due to their genetic as well as phenotypic difference form local white cultivar.

Table I. ***Capsules m^{-2}, number of capsules plant^{-1}, number of seeds capsule^{-1}, shelling %, thousand seeds weight (g), stover yield (kg ha^{-1}), seed yield (kg ha^{-1}) and harvest index % of sesame cultivars as affected by sowing dates and nitrogen levels***

Treatment	Capsules m^{-2}	No. of capsules plant^{-1}	No. of seeds capsule^{-1}	Shelling %	1000 seed weight (g)	Stover yield (Kg ha^{-1})	Seed yield (Kg ha^{-1})	H.I %
Sowing dates (D)								
20th June	1130 a	102 a	69 a	67 a	3.78 a	6318 a	1135 a	15 a
10th July	654 b	60 b	55 b	63 b	3.44 b	3600 b	433 b	13 b
30th July	489 c	44 c	56 b	63 b	2.89 c	2087 c	306 c	11 c
LSD (0.05)	55.03	4.10	1.29	1.23	0.05	268	56.68	0.95
Sesame cultivars (V)								
Local White	739	67 b	59 b	64	3.37	3706 b	554 b	12 b
Local Black	776	71 a	61 a	65	3.38	4297 a	696 a	14 a
Nitrogen (kg ha^{-1})								
0	501 d	47 d	47 d	58 d	2.72 d	2562 d	339 d	10 d
40	708 c	64 c	57 c	62 c	3.12 c	3627 c	609 c	13 c
80	871 b	79 b	65 b	67 b	3.56 b	4467 b	718 b	14 b
120	951 a	86 a	70 a	70 a	4.08 a	5351 a	833 a	15 a
LSD (0.05)	31.84	2.32	0.86	0.42	0.07	268.6	24.35	0.59
Interaction								
D x V	ns	ns	ns	ns	ns	ns	ns	ns
D x N	ns	ns	ns	ns	*	ns	ns	ns
N x V	ns	ns	ns	*	ns	ns	ns	ns
D x V x N	ns	*	*	ns	ns	*	*	ns

Means in the same category followed by different letters are significantly different at $P \leq 0.05$ levels. ns = non-significant

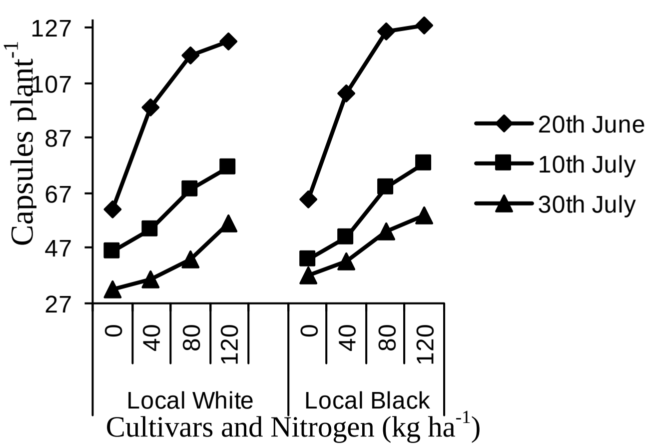

Fig.1. Capsules plant^{-1} is affected by sowing dates, cultivars and nitrogen levels.

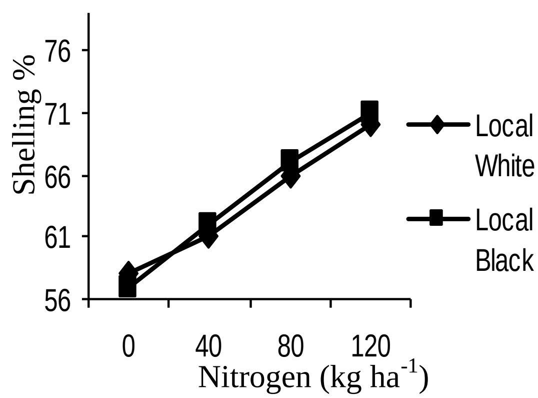

Fig. 2. Shelling (%) is affected by cultivars and nitrogen levels.

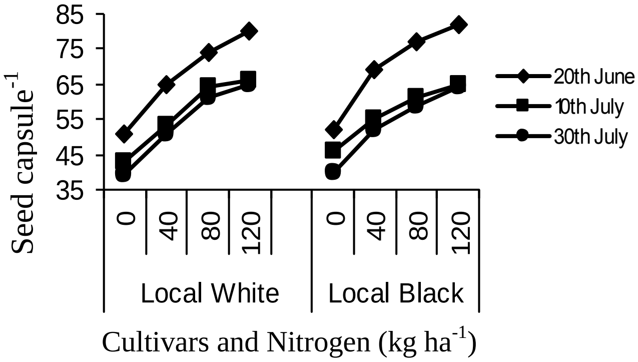

Fig.3. Seed capsule^{-1} is affected by sowing dates, cultivars and nitrogen levels.

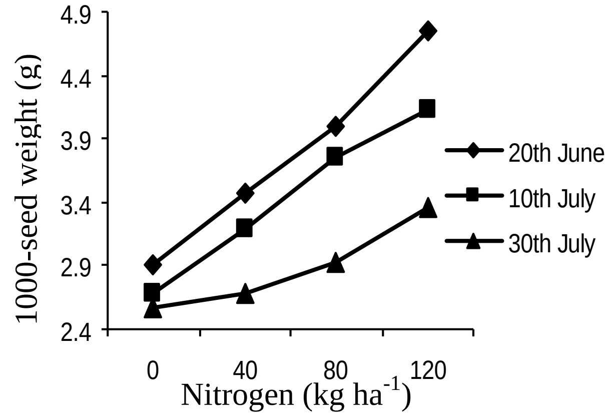

Fig. 4. 1000 seeds weight is affected by sowing dates and nitrogen levels.

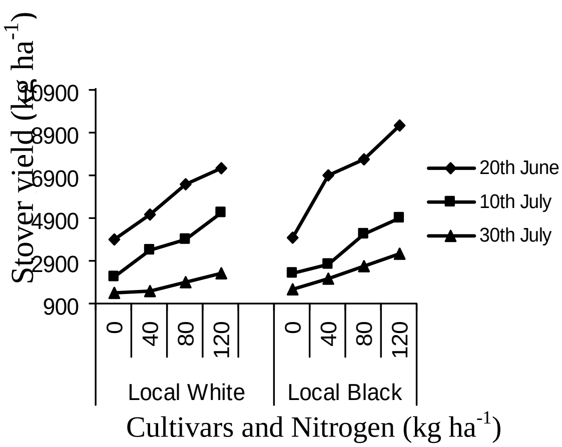

Fig. 5. Stover yield is affected by sowing dates, cultivars and nitrogen levels

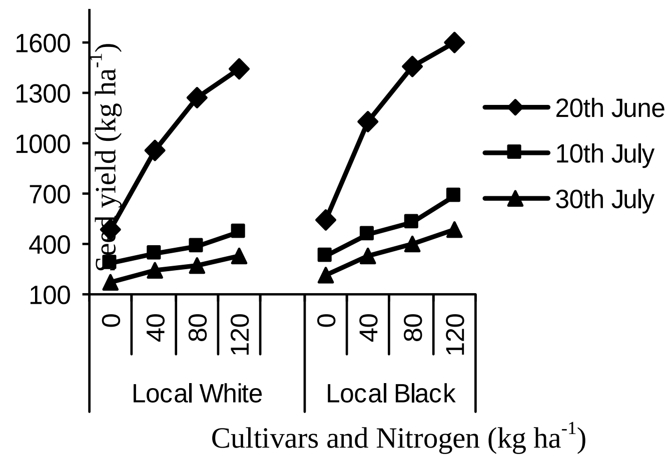

Fig. 6. Seed yield is affected by sowing dates, cultivars and nitrogen levels

CONCLUSION AND RECOMMENDATIONS

The present research work recommend that the two local cultivars should be sown up to 20th June with 120 kg N ha^{-1} for higher yield. Promotion of Local black cultivar based on its better performance is suggested for the study area.

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