Journal of Environment and Earth Science
ISSN 2224-3216 (Paper) ISSN 2225-0948 (Online)
Vol.4, No.22, 2014

Sowing Dates and Nitrogen Levels Effect on Morpo-Phenological Traits of Sesame Cultivars

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ABSTRACT

Field experiment entitled "Sowing dates and nitrogen levels effect on morpo-phenological traits of sesame cultivars" was conducted at New Developmental Farm The University of Agriculture, Peshawar, Pakistan during kharif 2012. The experiment was laid out in randomized complete block design 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}) to sub plots. Plants sown on 20th June had significantly delayed flowering (52 days), days to maturity (105), improved plant height (197 cm), branches plant^{-1}(15), capsule length (2.78 cm) and biological yield (7453 kg ha^{-1}) as compared with other sowing dates. Sesame local black cultivar had significantly more branches plant^{-1}(14), and biological yield (4993 kg ha^{-1}) but its capsule length and days to maturity were significantly lower from local white cultivar. Plots treated with 120 kg N ha^{-1} produced maximum days to first flowering (50), plant height (178cm), branches plant^{-1}(18), days to maturity (104), capsule length (2.96 cm) and biological yield (6184 kg ha^{-1}). The interaction between sowing dates, nitrogen level and sesame cultivars indicated that crop sown on 20th June with local black cultivar and treated with 120 kg N ha^{-1} had maximum plant height, day to maturity and biological yield. Hence local black cultivar sown on 20th June and treated with 120 kg N ha^{-1} produced the best results in terms of plant height, branches plant^{-1} and biological yield.

Key Words: *Sesame (Sesamum indicum L.), sowing dates, nitrogen levels, sesame cultivars, phenology, morphology*

INTRODUCTION

Sesame (*Sesamum indicum* L.) belongs to family pedaliaceae. It is an annual, self-pollinated and indeterminate minor kharif oilseed crop. Sesame is one of the ancient oil seed crops used by man and is cultivated from tropical to temperate regions of the world. Capsules mature form bottom to top, allowing shattering of the lower ones by the time the uppermost capsules are mature. It is a short-day plant, normally flowering in 42-45 days. Sesame seed are small and ovate with two distinct types, cream-coloured and black cream-coloured seed are preferred (Qadeer, 1998). It 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 and bread than eaten as confectionery. The crop has high content of both excellent quality edible oil (42–54%) and protein (22 to 25%). Its oil has high degrees of stability and resistance to rancidity. (Alpaslan et al., 2001). Its oil is colorless, odorless and has a long shelf-life which used for cooking, medicinal, salad, soap and margarine (Qadeer, 1998). This important crop called the queen of vegetable oils has been cultivated for centuries, particularly in the developing countries of Asia and Africa. In Pakistan, sesame was cultivated on an area of 77.6 thousand hectares with an annual production of 31 thousand tones and an average yield of 401 kg ha^{-1} in Pakistan whereas in Khyber Pakhtunkhwa its average yield was 1000 kg ha^{-1} (MINFA, 2011). Sesame is considered as a drought tolerant crop. Yield decreases progressively with the delay in planting. The effect of photoperiodism on sesame has been thoroughly studied, since this is a major factor influencing biological yield (Alamsarkar et al. 2007). Sesame yield is highly variable depending upon the growing environment, cultural practices and cultivars. In India, sowing on 15th May attained taller plant height, maximum branches plant^{-1}, leaves plant^{-1}, capsule length and stover yield 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 plant height and dry matter of sesame has increased significantly with increase nitrogen up to 150 kg ha^{-1} (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, leaves plant^{-1} and thus ensuring good seed and dry matter yield (Ahmad et al. 2001). Ramakrishnan et al., 1994 reported that the application of nitrogen up to 140 kg ha^{-1} increased significantly branches plant^{-1}, plant height, capsule length, leaves plant^{-1} and biological yield of sesame cultivar. Keeping in view the above constraints this experiment was conducted to find out the optimum sowing date, nitrogen level and cultivar for higher yield at the agro-climatic condition of Peshawar.

MATERIALS AND METHODS

To find out the effect of sowing dates and nitrogen levels on plant growth of sesame cultivars, an experiment was conducted at New Developmental Farm The University of Agriculture, Peshawar, Pakistan during kharif, 2012. The site is located at (34^o 00 N, 71^o 30 E, 510 MASL). The experiment was laid out in randomized complete block design 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}) to sub plots. A subplot size of 2.4 x 3 m was used. Each sub plot was consisted of 6 rows having 40 cm row-to-row distance. Phosphorus as P_2O_5 was applied at the rate of 60 kg ha^{-1}, as a basal dose whereas half of nitrogen was applied at the time of sowing and the remaining half was applied before flowering stage. Seed were sown at rate of 4 kg ha^{-1}. Data on days to first flowering were recorded in each subplot when first flowers appeared on plants. Plant height (cm) was measured at harvesting stage. Data were recorded by measuring plants form ground level to the top of the five randomly selected plants in each subplot through measuring tape. Data on days to maturity were recorded when more than 75% of the plants in each sub plot showed signs of physiological maturity. Number of branches plant^{-1} was counted in ten plants selected randomly in each subplot and then it was average. After harvesting capsule length (cm) of ten randomly selected capsules were measured with measuring tape. Data on biological yield was taken in four central rows in each subplot at harvest. Harvested crop was sun dried and weighed by using electronic balance and then converted into kg ha^{-1} by the following formula.

$$\text{Biological yield (kg ha}^{-1}) = \frac{\text{Weight of plant materials in four rows (kg)}}{\text{No of rows x Row length x R-R}} \times 10{,}000 \text{ m}^2$$

Data were analyzed using the statistical package MSTAT-C (Steel and Torrie 1980) and the significant differences among the treatments were determined using least significant difference (LSD) test at 5% level of probability.

Table I. Temperature (C°), rainfall (mm), and relative humidity % of the experimental site for the growing period of the sesame crop (June-October 2012)

Month	Mean temperature (C°)		Mean rainfall (mm)	R.H (%)
	Minimum	Maximum		
June	22	43	0	35
July	27	41	100	56
August	26	38	100	59
September	23	35	110	70
October	15	31	100	56

Metrological station: Pakistan Forest Institute Peshawar.

RESULTS AND DISCUSSION

Days to first flowering

Plots sown on 20th June took significantly more days (52) to first flowering while early days to first flowering (46) were recorded when crop was sown on 30th July. This was probably because of the short dry spell and relatively high evaporation rate which could have reduced the vegetative duration, thereby hastening flowering. Similar results were reported by Olowe (2007), that sesame sown in late July and mid August flowered earlier by 5–7 days than those sown early in the season. The effect of nitrogen on days to first flowering was significant. Increasing nitrogen levels significantly delayed days to first flowering. Plots treated with 120 kg N ha^{-1} delayed flowering (50 days) as compared to control, which took plots early 47 days to first flowering. The possible reason should be that accessibility and uptake of nitrogen which leads to comparative prolonged days to first flowering with more vegetative growth. This finding agrees with the reports of El-Nakhlawy and Shaheen (2009), who reported that nitrogen improve vegetative growth and delayed days to first flowering. The interaction between D x N revealed in Fig. 1that early sown crops have no direct influence on days o first flowering with increasing nitrogen rate. However crops sown on 10th July, have significantly delayed days to first flowering with increasing N rates. Late sown crops have delayed the days to first flowering when N rates was increased up to 80 kg ha^{-1}, with further increasing , there were significant differences.

Plant height (cm)

Data regarding plant height are presented in table II showed that crop planted on 20th June attained significantly maximum height (197 cm) while minimum height (142 cm) was recorded for crop sown on 30th July. The possible reason could be that early sown crop had availed prolonged photoperiod for vegetative growth as a result plant attained maximum plant height as compared to late sown crop. These results are in line with those of Ogbonna and Umar-Shaaba (2011) and Alamsarkar et al. (2007) who reported that crop which was sown at 15th June produced significantly taller plants while sown on 05th July produced dwarf plant. In case of nitrogen levels the plots treated with 120 kg N ha^{-1} attained maximum plant height (178 cm) while minimum plant height (143 cm) were recorded in control plots. These results are accordance with Ali and Ahmed (2012), Malik et al. (2003) and Shehu et al. (2010). Who reported that increase in plant height might be due to the functional role of nitrogen in the plant body. Plant height increased with increase in nitrogen level. Interaction between D x V x N indicated in Fig. 2 that plant height of cultivars sown on 20th June increased with increase in nitrogen levels however when the sowing was delayed to 10th July the response of nitrogen application was not as effect as seen on 20th June and plant height remain almost similar in both the sowing dates (10th and 30th July).

Number branches plant^{-1}

Mean values of the data indicated in table II that number of branches plant^{-1} were significantly affected by sowing dates, sesame cultivars and nitrogen levels. Crop sown on 20th June produced maximum number of branches plant^{-1} (15) while minimum number of branches plant^{-1} (10) was observed when crop was sown on 30th July. The reason could be that early sowing crop which has prolonged photoperiod as a result of more assimilates was utilized by plant in producing more branches as compared to late sown crop. These results are in conformity with the findings of Rahman et al. (2007) and Alamsarkar et al. (2007). Increasing in nitrogen level significantly increase in number of branches plant^{-1} was recorded. Plots treated with 120 kg N ha^{-1} produced maximum number of branches plant^{-1} (18) while minimum number of branches plant^{-1} (7) was observed in control plots. These results are in line with Malik et al. (2003), Sharar et al. (2000) and Shehu et al. (2010), who recorded that nitrogen fertilizer application had significant effect on number of branches plant^{-1} with increase the nitrogen level branches plant^{-1} increased up to (40 %) if we compared with control plots. Local black cultivar produced maximum number of branches plant^{-1} (14) as compared to local white cultivar (11). Interaction between D x N showed in Fig. 3 that early sown crops have no direct influence on number of branches plant^{-1} with increasing nitrogen rate. However crops sown on 10th July, have significantly increase number of branches plant^{-1} with increasing N rates. Late sown crops have increased number of branches plant^{-1} when N rates was increased up to 80 kg ha^{-1}, with further increasing , there were significant differences.

Physiological maturity

Mean value of days to maturity given in table II showed that maturity was significantly delayed when crop was sown on 20th June (105 days) while early maturity were noted when sesame sown on 30th July (98 days). Similar results were reported by Olowe (2007) and Ogbonna and Umar-Shaaba (2011). They reported that early sowing delay physiological maturity as compared to late sowing it could be due to early sown crop had availed prolonged photoperiod for vegetative growth as a result plant attained maximum days to maturity. The effect of nitrogen levels on days to maturity was significant. Delayed maturity with increasing nitrogen level up to 80 kg N ha^{-1} was observed as compared with control plots. The possible reason should be that accessibility and uptake of nitrogen which leads to comparative prolonged days to maturity with more vegetative growth. This agreed with the finding delay in maturity with increase nitrogen level as compared to control plots has been reported by El-Nakhlawy and Shaheen (2009). Sesame cultivar local white took maximum days (103) to maturity as compared to local black (101 days). The possible reason could be genetic constitution of sesame cultivars that affect days to maturity. Interaction between D x V x N indicated in Fig. 4 that days to maturity of cultivars sown on 20th June increase with increase in nitrogen levels however when the sowing was late to 30th July the response of nitrogen application was not as effect as seen on 20th June and days to maturity remain almost similar in both the sowing dates (20th June and 10th July).

Capsule length (cm)

Data regarding capsule length given in table II revealed that crop sown on 20th June produced maximum capsule length (2.78 cm) while minimum (2.45 cm) capsule length was obtained when crop sown on 30th July. It might be due to early sown crop had avail prolonged photoperiod for vegetative growth as a result plant attained maximum capsule length as compared to late sown crop. These results are agrees with those reported by Ogbonna and Umar-Shaaba (2011) and Alamsarkar et al. (2007) who reported that crop sown on 10th June produced maximum (3 cm) capsule length while late sown crop capsule length reduced up to (35%). Capsule length increase with increasing nitrogen levels and maximum capsule length (2.96 cm) was recorded for 120 kg N ha^{-1} while minimum capsule length (2.24 cm) was produced in control plots. Similar results were reported by Jouyban and Moosave (2011) who observed that nitrogen increase capsule length with increase the nitrogen level up to 150 kg ha^{-1} as compared to control plots. Local white cultivar produced maximum (2.69 cm) capsule length as compared to local black cultivar (2.61 cm). Interaction between D x N showed in Fig. 5 that cultivars had almost equal capsule length when nitrogen was not applied irresponsive of the sowing date however with increase in nitrogen level change in capsule length in response to nitrogen were observed. The early sowing date had more capsule length as compared to late sowing 30th July.

Biological yield (kg ha^{-1})

Mean value of sowing dates showed in table II that biological yield significantly reduced with delaying in sowing. Plots sown on 20th June had significantly higher biological yield (7453 kg ha^{-1}) while lowest biological yield (2393 kg ha^{-1}) was recorded for 30th July sowing. These results are in line with those Alamsarkar et al. (2007) who reported that early sowing (15th June) produced taller plants and more number of branches plant^{-1} and increased vegetative growth of plant under favorable weather as a resulted more biological yield as compared to late sowing. Local black cultivar recorded maximum (4993 kg ha^{-1}) biological yield as compared to local white cultivar (4260 kg ha^{-1}). It may be due to their genetic as well as phenotypic difference form local white cultivar. Increasing nitrogen level biological yield increase significantly and therefore the highest level of nitrogen (120 kg ha^{-1}) produced maximum biological yield (6148 kg ha^{-1}) while lowest yield is recorded in control plot (2900 kg ha^{-1}). Nitrogen fertilizer delay physiological maturity due to this extended the vegetative period of the crop, plant attained maximum branches plant^{-1} and plant height thus increase biological yield. These results are in line with the findings of Shehu et al. (2010) who reported that significantly higher in biological yield produced with increased nitrogen level. The interaction between D x V x N indicated by Fig. 6 that both cultivars produced maximum biological yield when sown on 20th June and increased with increase in N fertilizers. Early sown crop had maximum biological yield even when nitrogen was not added as compared with other sowing dates.

Table II. Days to first flowering, plant height (cm) number of branches plant^{-1}, physiological maturity, capsule length (cm) and biological yield (kg ha^{-1}) of sesame cultivars as affected by sowing dates and nitrogen levels

Treatment	Days to first flowering	Plant height (cm)	Branches plant^{-1}	Physiological maturity	Capsule length (cm)	Biological yield (kg ha^{-1})
Sowing dates						
20th June	52 a	197 a	15 a	105 a	2.78 a	7453 a
10th July	47 b	143 b	12 b	103 b	2.71 b	4033 b
30th July	46 c	142 b	10 c	98 c	2.45 b	2393 c
LSD (0.05)	1.53	8.11	1.20	0.93	1.29	306.9
Sesame cultivars						
Local White	48	158	11 b	103 a	2.69 a	4260 b
Local Black	48	164	14 a	101 b	2.61 b	4993 a
Nitrogen(kg ha^{-1})						
0	47 d	143 d	7 d	101 b	2.24 d	2900 d
40	48 c	155 c	12 c	101 b	2.54 c	4236 c
80	49 b	167 b	14 d	103 a	2.80 b	5185 b
120	50 a	178 a	18 a	104 a	2.96 a	6184 a
LSD (0.05)	0.77	3.08	0.78	0.85	0.86	267.1
Interaction						
D x V	ns	ns	ns	ns	ns	ns
D x N	*	ns	*	ns	*	ns
N x V	ns	ns	ns	ns	ns	ns
D x V x N	ns	*	ns	*	ns	*

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

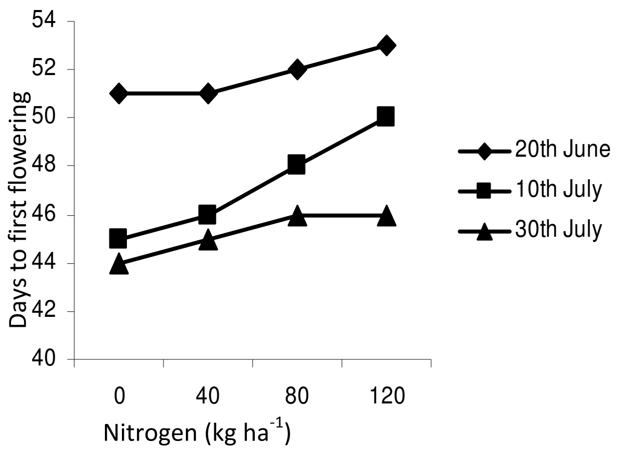

Fig. 1. Days to flowering of sesame is affected by sowing dates and nitrogen levels.

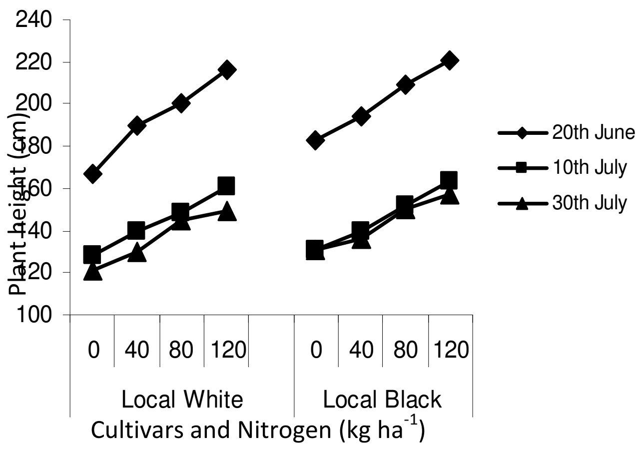

Fig. 2. Plant height of sesame is affected by sowing dates, cultivars and nitrogen levels.

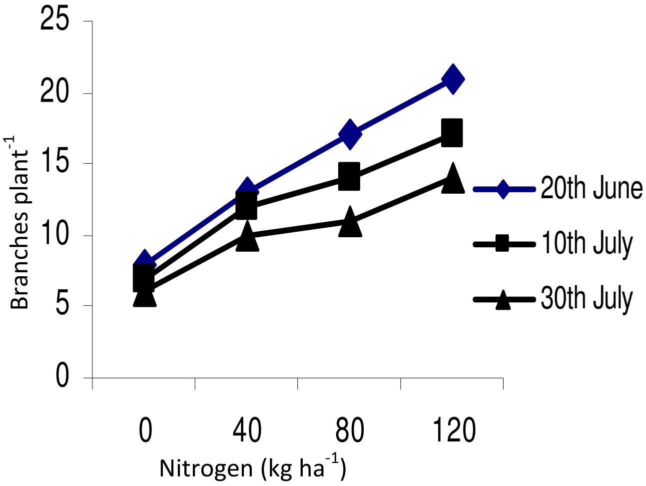

Fig. 3. Branches plant^{-1} of sesame is affected by sowing dates and nitrogen levels.

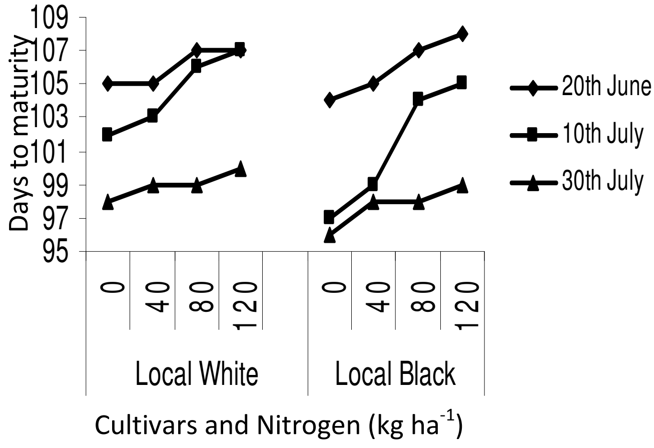

Fig. 4. Days to maturity of sesame is affected by sowing dates, cultivars and nitrogen levels.

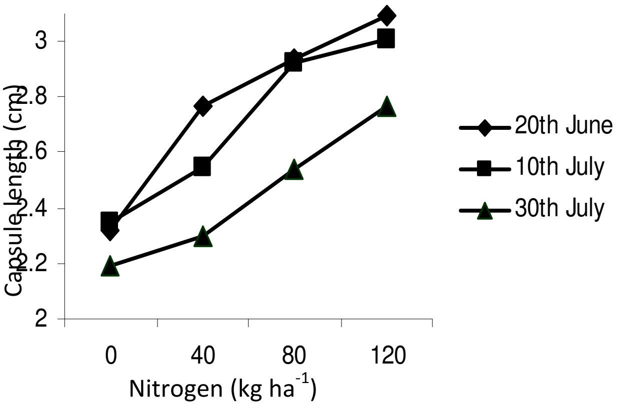

Fig. 5. Capsules length of sesame is affected by sowing dates, cultivars and nitrogen levels.

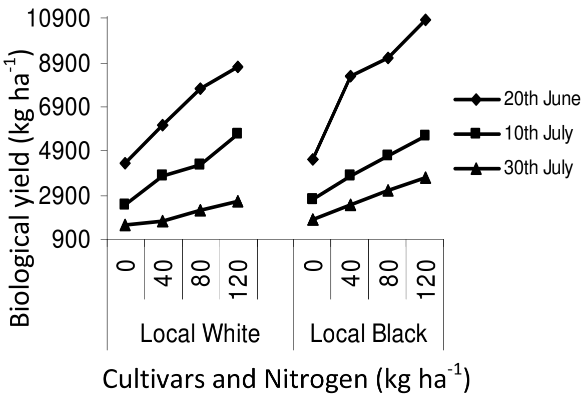

Fig. 6. Biological yield of sesame is affected by sowing dates, cultivars and nitrogen levels.

CONCLUSION AND RECOMMENDATIONS

From present study it can be concluded that cultivar local black sown on 20th June and treated with 120 kg N ha^{-1} delayed days to first flowering, physiological maturity, improved plant height, branches plant^{-1} and biological yield significantly and therefore, it is recommended that cultivar local black sown on 20th June and application of nitrogen at the rate of 120 kg ha^{-1} for improved biomass productivity in agro-climatic condition of Peshawar valley.

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