ISSN (Print) : 0974-6846
Indian Journal of Science and Technology, *Vol 9(30), DOI: 10.17485/ijst/2016/v9i30/89371, August 2016* ISSN (Online) : 0974-5645

Seed Yield and Oil Content of Sesame (Sesamum indicum L.) Genotypes in Response to Different Methods of Nitrogen Application

Hilal Kashani[1*], Shahab-u-Din[2], M. N. Kandhro[1], Nazeer Ahmed[2], Zahid Saeed[3] and Asif Nadeem[3]

[1]Department of Agronomy, SAU, Tandojam, Pakistan; kandhromn@gmail.com
[2]Livestock Research Institute (BAR&DC), PARC, Turbat, Pakistan; shahabkashani64@gmail.com
[3]Department of Agriculture Extension, Panjgoor, Balochistan, Pakistan

Abstract

Background/Objectives: Nutrients deficiency and imbalanced use of fertilizers are amongst the main factors responsible for low sesame yield. The study was conducted to determine the suitable nitrogen application method for optimum yield of sesame. **Methods/Statistical Analysis:** This study consisted of three nitrogen application methods i.e. broadcasting:100 kg N ha-1 (check), integration of foliar N (1%) + broadcasting (50 kg N ha-1) and fertigation (100 kg N ha-1), and three sesame varieties viz. S-17, PR-122 and PR-509. The experiment was carried out in three replicated RCBD (factorial) at SAU, Tandojam, Pakistan during summer, 2013. The data was statistically analyzed using Statistix computer software to determine the significance of variance. **Findings:** Growth, yield and oil content of sesame genotypes was significantly ($P<0.05$) affected by various nitrogen application methods as compared to check. The integrated application of 1% foliar N + broadcasting at the rate of 50 kg N ha-1 was found superior for improving yield of sesame crop. The sesame plots given nitrogen through fertigation followed in performance. However, lowest seed yield was recorded in broadcasting (100 kg N ha-1). As regard varieties, better performance in terms of growth and yield traits was noted in S-17, followed by PR-509. However, minimum seed yield was noted in PR-122. As regards, interactive effects, maximum seed yield was observed in the interaction of combined application of foliar N (1%)+broadcasting (50 kg N ha-1) x variety S-17. **Application/ Improvements:** Application of nitrogen could be made effective and economical by integrating 1% foliar nitrogen with 50% reduced dose (broadcasting) for enhancing seed yield of sesame.

Keywords: N Application, Sesame Varieties, Seed Yield and Oil Content

1. Introduction

The sesame (*Sesamum indicum* L.) crop is cultivated for edible oil purpose in Sindh as well as overall Pakistan. The majority of the wild species of the genus *Sesamum* are native to Africa, but its first domestication is recorded in the India sub-continent[1]. Sesame seeds have a high nutritive value and seeds are used in baking products and oil extraction. It is considered as a drought tolerant crop[2]. The crop is the queen of vegetable oils and the oil has high degrees of stability and resistance to rancidity[3]. Apart from being oil yielding plant species, sesame also possesses many agronomic advantages like, capacity to set seeds under high temperature, a deep tap root system that grows well by intercropping and fits well into crop rotation[4]. Due to population expansion, the horizontal increase in area and crop productivity is becoming limiting. Hence, efforts are underway to increase crop productivity vertically. Furthermore, through proper management cost of production is to minimize[5]. Nitrogen is considered highly volatile element, its injudicious application to crops increases pollution and cost of inputs

* *Author for correspondence*

as well[6]. Nitrogen is one of the essential macronutrients. It is necessary for synthesizing amino acids, nucleic acids, ribosomes, proteins, chlorophyll, cytochrome, coenzymes and some vitamins[7]. Sesame crop has been found to respond highly to nitrogen. Nitrogen is very essential for growth of plants and shares 1–4% dry matter production of plants. It helps in utilization of elements like phosphorus and potassium in plants. If nitrogen is deficient, optimum amount of phosphorus and potassium could not be utilized efficiently in soil[8]. Application of nitrogen at appropriate amount increases the crop yield and improves soil N status[9]. Sesame seed production could be raised upto 50% through proper fertilization[11]. It has been observed that fertilizer efficiency particularly urea application through soil is not as effective as it is applied to plants through foliage along with soil application. Such application methods ensure the availability of nutrients to crops for obtaining higher yield. In modern agriculture, fertigation (combined application of irrigation and nitrogen) is gaining popularity due to its beneficial effect in contrast to application of N through broadcasting[12]. The response of sesame to foliar applied N was promising when applied in addition to a basal dose of N along with P and K[13]. The economic benefits were higher when sesame crop was fertilized through fertigation[14]. In a study[4] suggested that lax branching and small flower were promising mutants as they possessed higher seed yield and enhanced fatty oil content than the parental cultivar but protein content was lower in the mutants. Considering the above mentioned facts, this study was conducted to evaluate the nitrogen application methods effect on yield and oil content of sesame varieties under Tandojam environment.

2. Material and Methods

The experiment under field conditions was undertaken during summer 2013 at Students' Experimental Farm, Sindh Agriculture University, and Tandojam, Pakistan. The experimental design used was randomized complete block design (factorial) having three replications. The treatments comprised of three nitrogen application methods (Broadcasting @ 100 kg N ha^{-1}, Foliar application @ 1% N+ broadcasting: 50 kg N ha^{-1} and Fertigation @ 100 kg ha^{-1}) and three sesame varieties (S-17, PR-122 and PR-509). Each replicate was subjected to interactive effect of four Nitrogen application methods on three sesame varieties. The experimental land was prepared thoroughly. The soil was well worked by using disc plow, followed by disc harrow and leveled. After soaking dose, the plots were given two cross-wise cultivator plowings. Clods were crushed to eradicate the weeds followed by planking for uniform distribution of irrigation water. For sowing, the seed was obtained from Oilseed Section, ARI, Tandojam, Sindh, Pakistan. The sowing of the experimental crop was done single row drill keeping 22.5 cm distance between plants and 45 cm distance between rows. Nitrogen was applied in the form of urea. The application of nitrogen through broadcasting and fertigation was done in two splits; half at sowing time and remaining half at 1stirrigation. The 1% foliar application of nitrogen was done at reproductive stage through spray by dissolving 2.17 kg of urea in 100 liters of water. The observations were recorded on growth and yield parameters such as plant height (cm), pods $plant^{-1}$, seeds pod^{-1}; seed yield (kg ha^{-1}) and oil content (%). The data was statistically analyzed using Statistix computer software to determine the significance of variance.[15]. The LSD test was applied for comparing the superiority of treatments.

3. Results and Discussion

The statistical analysis of data showed that nitrogen application methods, varieties and their interaction are shown in Tables 1 to 5 significantly ($P<0.05$) influenced growth and yield of sesame. In case of nitrogen application methods, foliar application @ 1% N+ broadcasting: 50 kg N ha^{-1} showed superiority in performance over rest of the methods. This method was found effective for nitrogen application resulting in 158.5 cm plant height, 90.6 pods $plant^{-1}$, 35.7 seeds pod^{-1}, 719.9 kg ha^{-1} seed yield and 51.4 % oil content. Fertigation @ 100 kg ha^{-1} ranked 2nd in agronomic performance with 156.9 cm plant height, 89.4 pods $plant^{-1}$, 34.5 seeds pod^{-1}, 709.4 kg ha^{-1} seed yield and 50.1% oil content. Nevertheless, reduced growth and yield response of sesame with 128.8 cm plant height, 66.6 pods $plant^{-1}$, 22.3 seeds pod^{-1}, 533.4 kg ha^{-1} seed yield and 41.5% oil content. The growth and yield performance of any crop is better when it is supplied with optimum dose of fertilizer at particular stage. In this study the better performance of sesame under foliar application @ 1% N+ broadcasting: 50 kg N ha^{-1} was possibly due to supply of nitrogen in optimum quantity at specific stage

(initial growth and supplement at flowering stage). The increasing growth and yield traits perhaps resulted in highest sesame crop yield due integration of foliar + soil applied nitrogen. The fertilization of crop with 100% N through soil alone probably did not fulfill the nutritional demand of sesame crop plants throughout their life cycle. Combined application of N through soil along with foliar application might supply nutrients steadily for meeting metabolic needs of crop with least loss. The results are accordance with the findings of[13] who reported that the response of sesame to foliar applied N was promising when applied in addition to a basal dose of N along with P and K. In another study[9] revealed that application of nitrogen in adequate amount not only increases crop yield also improves N status of soil. Among sesame varieties, maximum plant height (143.6 cm), pods plant^{-1} (82.1), seeds pod^{-1} (30.20), seed yield (646.7 kg ha^{-1}) and oil content (45.5 %) were recorded in variety S-17, followed by varietyPR-509 with 132.5 cm plant height, 70.7 pods plant^{-1}, 25.4 seeds pod^{-1}, 544.7 kg ha^{-1} seed yield and 44.4% oil content. However, lowest 131.0 cm plant height, 69.9 pods plant^{-1}, 24.4 seeds pod^{-1}, 536.3 kg ha^{-1} seed yield and 43.9 % oil content was noted in variety PR-122. In case of interactive effects, maximum plant height (166.4 cm) pods plant^{-1} (101.4), seeds pod^{-1} (39.0), seed yield (810.3 kg ha^{-1}) and oil content (52.4 %) were observed in the interaction of foliar application @ 1% N+ broadcasting x variety S-17 whereas, minimum plant height (123.4 cm) pods plant^{-1} (65.1), seeds pod^{-1} (19.3), seed yield (498.0 kg ha^{-1}) and oil content (41.1 %) were registered in the interaction of Broadcasting @ 100 kg N ha^{-1} x variety PR-122.The interaction between nitrogen levels and sesame varieties were found significant. The results are in conformity with those of[7] who revealed that increase in dry matter percentage of potato plant with nitrogen application might be due to the fact that higher doses of nitrogen might have helped in the production of photosynthesis, resulting in the accumulation of dry matter to be higher in the storage part i.e. tuber. The findings of this research with those of[8] who reported that sesame cultivar TS-3 produced markedly maximum seed yield as compared to rest of the cultivars possibly due to greater capsules plant^{-1}, seeds capsule^{-1} and seed index. This variety also produced maximum seed oil content (%). The yield contributing attributes played very important role increasing seed yield of sesame and these are agreement with findings of[9] who stated that seed yield per plant showed significant and positive association with number of pods per plant, days to maturity and number of seeds per pod. The results are supported by[2] who reported that application of nitrogen caused significant effects on sesame cultivars. Sesame cultivar Zarghan local recorded the highest yield (1724 kg ha^{-1}) and harvest index with the 90 kg N ha^{-1} rate and increased the protein accumulation by 25% compared to the control (no fertilizer) but sesame variety Darab[14] recorded higher oil and protein percentages. Among varieties, significantly (P<0.05) more plant height, capsules plant^{-1}, seeds plant^{-1}, 1000-seeds weight and seed yield were recorded in genotype TS-3[4]. The results are in concurrence with[2] that yield of legume seeds is highly dependent on the supply of plants with nitrogen, since its content is sufficiently large in vegetative organs and seeds.

Table 1. Plant height(cm) of sesame varieties as influenced by nitrogen application methods

Methods	Varieties			Mean
	S-17	PR-122	PR-509	
Broadcasting @ 100 kg N ha^{-1}	137.5	123.4	125.4	128.8 c
Foliar application @ 1% N+ Broadcasting: 50 kg N ha^{-1}	166.4	153.5	155.6	158.5 a
Fertigation @ 100 kg N ha^{-1})	165.3	151.8	153.5	156.9 b
Mean	143.6 a	131.0 c	132.5 b	-

Means sharing different letters in a column are significantly different at 0.05 probability level.

	Methods (M)	Varieties (V)	M x V
LSD 0.05	0.8307	0.7194	1.439

Table 2. Pods plant^{-1} of sesame varieties as influenced by nitrogen application methods

Methods	Varieties			Mean
	S-17	PR-122	PR-509	
Broadcasting @ 100 kg N ha^{-1}	71.5	65.2	64.0	66.6 c
Foliar application @ 1% N+ Broadcasting: 50 kg N ha^{-1}	101.4	84.7	85.5	90.6 a
Fertigation @ 100 kg N ha^{-1})	99.9	83.5	84.8	89.4 b
Mean	82.1 a	69.9 c	70.7 b	-

Means sharing different letters in a column are significantly different at 0.05 probability level.

	Methods (M)	Varieties (V)	M x V
LSD 0.05	0.7636	0.6613	1.323

Table 3. Seeds pod^{-1} of sesame varieties as influenced by nitrogen application methods

Methods	Varieties			Mean
	S-17	PR-122	PR-509	
Broadcasting @ 100 kg N ha^{-1}	26.7	19.3	20.8	22.3 c
Foliar application @ 1% N+ Broadcasting: 50 kg N ha^{-1}	39.0	33.4	34.5	35.6 a
Fertigation @ 100 kg N ha^{-1})	38.6	32.2	32.6	34.5 b
Mean	30.2 a	24.4 c	25.4 b	-

Means sharing different letters in a column are significantly different at 0.05 probability level.

	Methods (M)	Varieties (V)	M x V
LSD 0.05	0.6214	0.5381	1.076

Table 4. Seed yield (kg ha^{-1}) of sesame varieties as influenced by nitrogen application methods

Methods	Varieties			Mean
	S-17	PR-122	PR-509	
Broadcasting @ 100 kg N ha^{-1}	590.3	498.0	512.0	533.4
Foliar application @ 1% N+ Broadcasting: 50 kg N ha^{-1}	810.3	669.0	680.3	719.9
Fertigation @ 100 kg N ha^{-1})	790.0	667.0	671.3	709.4
Mean	646.7 a	536.3 b	544.7 b	-

Means sharing different letters in a column are significantly different at 0.05 probability level.

	Methods (M)	Varieties (V)	M x V
LSD 0.05	28.57	24.74	49.48

Table 5. Oil content (%) of sesame varieties as influenced by nitrogen application methods

Methods	Varieties			Mean
	S-17	PR-122	PR-509	
Broadcasting @ 100 kg N ha^{-1}	42.5	41.1	40.9	41.48 c
Foliar application @ 1% N+ Broadcasting: 50 kg N ha^{-1}	52.4	50.8	51.1	51.44 a
Fertigation @ 100 kg N ha^{-1})	50.6	49.3	50.5	50.12 b
Mean	45.5 a	43.9 b	44.4 b	-

Means sharing different letters in a column are significantly different at 0.05 probability level.

	Methods (M)	Varieties (V)	M x V
LSD 0.05	0.6871	0.5951	1.190

4. Conclusions

It is concluded that various methods of nitrogen application caused significant effects on the growth and yield of sesame varieties. Combined Foliar application at the rate of 1% N+ broadcasting: 50 kg N ha^{-1} showed superiority by producing maximum growth and yield traits, particularly seed yield (719.9 kg ha^{-1}) over rest of the methods. Among sesame varieties, maximum seed yield (646.7 kg ha^{-1}) was recorded in S-17. As regards, interactive effects, maximum (810.3 kg ha^{-1}) seed yield of sesame was recorded in the interaction of foliar application @ 1% N+ broadcasting x variety S-17.

5. References

1. Wikipedia. Sesame: from Wikipedia. Encyclopedia Wikimedia Foundation, Inc.; 2013.
2. Asghar MM, Farrukh SM, Mumtaz CA, Shamim A. Influence of different nitrogen levels on productivity of sesame (*Sesamum indicum* L.) under varying planting patterns. International Journal of Agriculture and Biology. 2003; 5(4):1-3.
3. Arif M, Chohan MA, Ali S, Gul R, Khan S. Response of wheat to foliar application of nutrients. Journal of Agriculture and Biological Sciences. 2006; 1(4):30-4.
4. Chowdhury S, Animesh KD, Aditi S, Sonali S, Rita P, Susmita M, Ananya D. Traits influencing yield in sesame (*Sesamum indicum* L.) and multilocational trials of yield parameters in some desirable plant types. Indian Journal of Science and Technology. 2010; 3(2). Doi no:10.17485/ijst/2010/v3i2/29670
5. Derby NE, Steel DD, Terpstra J, Knighton RE, Casey FXM. Interaction of nitrogen, weather, soil and irrigation on corn yield. Agronomy Journal. 2005; 97:1342-51.
6. Sripada RP, Heiniger RW, White JG, Weisz R. Aerial color infrared photography for determining late-season nitrogen requirements in corn. Agronomy Journal. 2005; 97:1443-97.
7. Noorka IR, Rehman S, Haidry JR, Khaliq I, Tabassam S, Din M. Effect of water stress on physicochemical properties of wheat (*Triticum aestivum* L.). Pakistan Journal of Botany.

2009; 41(6):2917-24.
8. Gul S, Khan MH, Khanday BA, Nabi S. Effect of sowing methods and NPK levels on growth and yield of rainfed maize (*Zea mays* L.). Scientifica. 2015. Doi no:10.1155/2015/198575.
9. Kalaiselvan P, Subrahmaniyan K, Balasubramanian TN. Effect of nitrogen on the growth and yield of sesame - A review. Agriculture Research. 2001; 22(2):137-40.
10. Hou Z, Pinfang L, Baoguo L, Jiang G, Yanna W. Effects of fertigation scheme on N uptake and N use efficiency in cotton. Plant and Soil. 2007; 290(1-2):115-26.
11. Jiusheng L, Bei L, Rao M. Spatial and temporal distributions of nitrogen and crop yield as affected by nonuniformity of sprinkler fertigation. Agriculture and Water Management. 2005; 76(3):160-80.
12. Muzzammil HS, Oad FC, Abbasi AMK, Gandahi AW. Effect of NPK, micronutrients and N-placement on the growth and yield of sunflower. Sarhad Journal of Agriculture. 2009; 25(1):45-52.
13. Ali EA, Ahmed SY. Influence of nitrogen rates and foliar spray by different concentration of copper on sesame seed and oil yields as well as nitrogen use efficiency in sandy soil. Research Journal of Agriculture and Biological Sciences. 2012; 8(2):174-8.
14. Anitta S, Fanish P, Muthukrishnan, Prem SS. Effect of drip fertigation in intensive maize (*Zea mays*) based intercropping system. Crop Research. 2012; 42(1-2-3):69-76.
15. Statistix. Statistix 8 user guide, version 1.0. Analytical Software. 2006.