

Effects of Bulb Source, Sowing Date and Nitrogen on Seed Yield of White Dehydration Onion in the Northern Sudan

Gaffer H. Mohamed ali¹ and Abdalla H. Nourai

Abstract

Experiments over three seasons at Hudebia Research Station, Northern Region, Sudan evaluated the effects of bulb source, sowing date and nitrogen nutrition on seed yield of the white dehydration onion cv. Nasi. The bulb sources used were whole bulbs and summer multiplied bulbs (splits obtained by the vegetative propagation of bulbs that produced seeds in the preceding winter). Whole bulbs consistently gave higher seed yields than summer multiplied bulbs. The optimum planting dates were mid-October to mid-November. Nitrogen fertilization appreciably increased onion seed yield in two years out of three.

Introduction

Onion is the most important vegetable crop in the Sudan. An estimated area of 84000 ha is planted annually, primarily as a winter crop for fresh consumption and dehydration. Recently there have been efforts to export fresh onions to Arabian Gulf and western European countries during November-May.

Provision of pure and reliable onion seeds is a pre-requisite for ensuring high crop yields. In the Sudan, the Northern Region is an important area for onion seed production. The region is characterized by a continental desert climate with a relatively cool, dry, long winter season which favours onion seed production. An average seed yield of more than 600 kg ha⁻¹ is normally produced by Northern Region farmers.

A recent review of onion flowering and seed production by Currah (1981) indicated that little research on onion seed production has been published from tropical areas. In the Sudan, although research on vegetable seed production is still in its infancy, onion seed production has attracted the attention of research scientists, whose findings were recently reviewed by Nourai (1983). In the Sudan, onion seeds are traditionally produced from whole bulbs produced from transplants grown in the preceding winter and stored in thatched sheds during the summer before planting for seed production. In this study an alternative technique using summer multiplied bulbs (splits obtained by the vegetative propagation of bulbs that produced seeds in the preceding winter) was also examined.

The present study was undertaken to evaluate effects of bulb source, sowing date and nitrogen nutrition on seed yield and the yield components of the white dehydration onion cv. Nasi and to identify the management practices which maximize onion seed production.

¹ Hudeiba Research Station, PO Box 31, Ed-Damer, Sudan

Materials and Methods

Three experiments were conducted at Hudebia Research Station (Lat. 17°34'N, Long. 33°56'E and elevation 350 m) in the arid region of Northern Sudan during the 1978-79, 1981-82 and 1982-83 seasons.

In 1978-79 the treatments investigated comprised a factorial combination of two bulb sources (whole bulbs, 4.5-5.5 cm and summer multiplied bulbs, 3.2-3.7 cm), Six sowing dates (9, 15 November, 1, 15 December 1978, 1, 15 January 1979 and four nitrogen levels (0, 43, 86 and 129 kg N ha⁻¹).

In 1981-82 the treatments tested were a factorial combination of two bulb sources (whole and summer multiplied bulbs), four sowing dates (1, 15 November, 1, 15 December 1981) and three nitrogen levels (0, 43 and 86 kg N ha⁻¹).

In 1982-83 only whole bulbs were used, and the factorial treatments combinations were of five sowing dates (8, 15 October, 1, 15 November and 1 December 1982 with the four nitrogen levels (0, 43, 86 and 129 kg N ha⁻¹).

The treatments were arranged in a randomized complete block design, replicated five times in 1978-79 and four times in 1981-82 and 1982-83. Bulbs were raised as twin rows on ridges 70 cm apart running north-south at a within-row spacing of 25 cm. Experimental plots consisted of three ridges each of a 7-10 m planting length. Nitrogen fertilizer in the form of urea was applied as two equal doses; the first one month after planting and the second two months later during seed development. However, in treatments involving only 43 kg N ha⁻¹ the fertilizer was applied as a single dose a month after planting. Plots were irrigated every 7-10 days and weeds and thrips infestations were kept at the lowest possible levels. At seed harvest, plant samples were taken to determine the number of umbels per plant, seed yield per plant and percentage flower abortion.

Results

Bulb source

The effect of bulb source on onion seed yield was marked (Tables 1 and 2). Statistical analysis indicated that yield differences between bulb sources were highly significant ($P=0.001$). The whole bulbs consistently out yielded summer multiplied bulbs. An overall percentage increases in yield of 69 and 38 were obtained in the 1978-79 and the 1981-82 seasons, respectively. The high seed yield obtained from whole bulbs was associated with an increased number of umbels and more seed yield per plant (Tables 1 and 2). The interaction between bulb source and sowing date on seed yield was significant (at $P=0.05$) only in the 1978-79 season.

Sowing date

Highly significant seed yield differences (at $P=0.001$) were obtained from sowing early in the winter season (Tables 1 and 3). An increase of nearly five-fold in seed yield was recorded following sowing in early November compared with sowing in mid January (Table 1). However the decrease in seed yield with delayed planting in 1981-82 (Table 2) was not significant ($P=0.05$). The reduction in seed yield as a result of late sowings was mainly a result of increased flower abortion (Table 1) and low seed yield per plant (Tables 1 and 3).

Nitrogen nutrition

The application of nitrogen fertilizer usually increased seed yield. Nitrogen application increased seed yield significantly (at $P=0.05$) in the 1981/82 and (at $P=0.001$) in the 1982-83 seasons, but the increase was not significant (at $P=0.05$) in the 1978-79 season. The increase in seed yield as a result of nitrogen application was a result of reduced flower abortion (Table 2, increased umbel number per plant (Table 3) and higher seed yield per plant (Tables 2 and 3). The interaction between nitrogen level and sowing dates on seed yield was significant (at $P=0.05$) in the 1978-79 and the 1982/83 seasons.

Discussion

The results indicated that higher onion seed yields were obtained by using whole bulbs rather than summer multiplied bulbs. This is in contrast with previous findings of El Hilo and Abu El-Goukh (1973, 1974) and El Hilo and Nourai (1975), where no differences were observed in seed yields from summer multiplied and whole bulbs. Recent work by Nourai (1982a), indicated that small whole bulbs and summer multiplied bulbs gave low seed yields compared with large whole bulbs.

Nitrogen application appreciably increased seed yield in two out of three seasons. Percentage yield increases averaged over the three seasons of 12, 21 and 49 were recorded following the application of 43, 86 and 129 kg N ha⁻¹ of urea fertilizer compared with the control. El Hilo et al (1970) reported that the lack of nitrogen induced yellowing of leaves and flower stalks and caused burning of leaf tips, in contrast to plants treated with nitrogen which remained green throughout the growing season. They also reported that nitrogen fertilizer application resulted in a high total nitrogen content in the leaves. Increased seed yields due to nitrogen application were also reported by El Hilo et al. (1971), El Hilo and Mohammed ali (1971) and Nourai (1982b). The increased seed yield after nitrogen application and reduced flower abortion may have been caused by increased nutrient availability to the developing flowers.

Marked reductions in onion seed yields were obtained with delayed planting in the 1978/79 and 1982/83 seasons. However, such decrease was not evident in 1981/82 probably because the sowing dates tested were within the optimum range of dates for planting onion bulbs for seed production. Reductions in seed yield with delayed sowing were associated with reductions in plant size, umbel size and total flower number. Plants of late sowings were also subject to adverse high temperatures during March-May unfavorable for seed setting and development. It has been reported that the planting depresses seed yield by reducing seed size, weight and total flower number (Abdalla 1969).

The significance of interactions between sowing date and bulb source indicated that reductions in seed yield with delayed sowings were more pronounced with whole bulbs than with summer multiplied bulbs. On the other hand the interaction between sowing date and nitrogen levels demonstrated that better utilization, of nitrogen fertilizer is achieved with early sowing.

Regression analysis to reveal the relations between the two variables, i. e., sowing date (x) and seed yield (y) indicated a highly significant ($P=0.01$) correlation coefficient ($r=0.79$). Although it was possible to account up to 62% of the variability in (y) by the linear equation: $Y = 1278 - 8.67X$, yet, a better fitting was given by the

quadratic curve of the equation: $Y = 1121.2095 + 2.7138X - 0.1161X^2$, accounting up to 71% of the variability in (Y).

Recommendations

1. The optimum planting dates of onion seed production is mid-October to mid-November.
2. Whole bulbs should be used to obtain high yields.
3. Nitrogen fertilization of 86 kg per hectare is recommended to be applied in two equal doses; one and two months after planting, as it proved to reduce flower abortion, increase number of umbels and seed yield per plant.

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Table I. Effect of bulb source, sowing date and nitrogen application on seed yield components of the white onion cv. Nasi 1978-79 season

Factor	Seed yield (kg ha ⁻¹)	No. umbels plant ⁻¹	Flower abortion (%)	Seed yield plant ⁻¹ (g)
Bulb Source				
Whole bulbs	1259	6.6	45.9	10.6
Summer-multiplied bulbs	746	4.0	44.6	6.2
SE	29***	0.22***	1.12	0.49***
Sowing date				
9 Nov.	1592	6.2	43.2	12.1
15 Nov.	1471	5.7	46.3	12.0
1 Dec.	1250	5.4	46.5	10.1
15 Dec.	895	5.7	41.7	8.3
1 Jan.	479	4.7	43.2	5.1
15 Jan.	328	4.2	50.4	2.8
SE	50** *	0.38**	1.94*	0.85***
Nitrogen applied (kg ha⁻¹)				
0	944	5.5	45.3	8.2
43	985	5.2	45.1	7.3
86	1074	5.3	47.6	8.1
129	1008	5.2	42.8	10.0
SE	17	0.31	1.58	0.69

*, **, ***: Significant at $P=0.05$, 0.01 and 0.001

Table 2. Effect of bulb source, sowing date and nitrogen application on seed yield components of the white onion cv. Nasi 1981-82 season

Factor	Seed yield (kg ha ⁻¹)	No. umbels plant ⁻¹	Flower abortion (%)	Seed yield plant ⁻¹ (g)
Bulb Source				
Whole bulbs	548	6.6	54.3	8.4
Summer-multiplied bulbs	396	4.6	51.8	6.6
SE	26***	0.25***	1.6	0.37**
Sowing date				
9 Nov.	485	4.9	56.2	6.0
15 Nov.	514	5.4	55.0	8.1
1 Dec.	473	5.8	52.2	7.7
15 Dec.	416	6.2	48.9	8.4
SE	36	0.35*	2.3	0.52**
Nitrogen applied (kg ha⁻¹)				
0	401	5.4	54.2	5.9
43	485	5.4	56.8	7.4
86	531	5.9	48.3	9.3
SE	31*	0.30	2.0*	0.45***

Table 3. Effect of bulb source, sowing date and nitrogen application on seed yield components of the white onion cv. Nasi 1982-83 season

Factor	Seed yield (kg ha⁻¹)	No. umbels plant⁻¹	Seed yield plant⁻¹ (g)
Sowing date			
8 Oct.	1133	6.2	9.8
15Oct.	1032	6.3	10.7
1 Nov.	992	8.0	14.4
15 Nov.	775	7.7	10.2
1 Dec.	973	7.7	10.4
SE	40***	0.29***	0.89**
Nitrogen applied (kg ha⁻¹)			
0	786	6.6	8.6
43	921	7.7	10.5
86	972	7.2	11.8
129	1101	7.3	13.5
SE	36***	0.26*	0.80**

*, **, ***: Significant at $P=0.05$, 0.01 and 0.001