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EFFECTS OF SOWING DATE AND INTRA-ROW SPACING ON THE PERFORMANCE OF SUNFLOWER IN THE NIGERIAN SAVANNA

B. Tanimu, S.G. Ado and S.A. Dadari.

Institute for Agricultural Research,
Ahmadu Bello University, Zaria, NIGERIA.

SUMMARY

The effects of four sowing dates (9th June, 23rd June, 12th July and 28th July) and six intra-row spacings (15, 20, 25, 30, 35 and 40 cm) on sunflower performance were studied for two years in the Nigerian savanna. Sowing date was found to have significantly affected plant height at flowering in both years. However, sowing date significantly affected grain yield in 1987 and the number of days to first flowering in 1988. Intra-row spacing significantly affected grain yield in both years and the number of days to first flowering in 1988. The interactions between the sowing dates and the intra-row spacings were significant for grain yield in 1987 and for plant height at flowering in 1988. Sowing from the last week of June to the second week of July at intra-row spacings between 25 and 30 cm gave highest grain yields.

INTRODUCTION

The growth and development of a crop can be influenced by a number of factors including genetic potentials and environmental factors. These factors may also affect the yield and quality of the crop. Time of sowing either under rainfed of irrigated condition is one of the important agronomic practices that affect the yield and other characters of any crop (Weiss, 1966). The time of sowing of a crop mainly depends on the prevailing weather conditions. In Nigeria, the optimum time of sowing for most rainfed crops has been the beginning of the rains. Since the length of the rainy season varies from 230 - 90 days from the Southern Guinea savanna to the Sahel Savanna of Nigeria, the optimum sowing date is also expected to vary from the south to the north. The onset of rains in any given year, however, is diffucult to assess with a high degree of accuracy as this varies from year to year and place to place (Kowal and Knabe, 1972). This thus makes it difficult to recommend a definite sowing date for any crop. If sown late, the yield suffers due to the limited period that the crop gets water needed for its vegetative growth. According to Johnson and Jellum (1972), highest seed yields and oil percentage in seeds were produced when sunflowers were planted from mid-June to mid-July.

The effects of spacing on crop growth and yield is obvious because under wide spacing, the individual plant is subjected to lesser degree of competition from its counterparts due to more available space, but the population density is much reduced. Bleasdale (1966) and Gupta (1982) reported that if a crop is grown at a range of population densities and all the plants harvested at one time, it is generally supposed that the total dry matter yield per unit area will increase with increasing density until a

Table 1. Effects of sowing date and intra-row spacing on the number of leaves of sunflower at flowering at Samaru in 1987 and 1988

Date of Sowing	1987 Intra-row spacing (cm)							1988 Intra-row spacing						
	15	20	25	30	35	40	Mean	15	20	25	30	35	40	Mean
June 9	18	17	18	16	16	18	17	19	18	18	20	19	19	19
June 23	18	18	17	17	18	19	18	20	19	19	18	17	18	18
July 12	19	20	19	20	19	21	20	18	19	17	19	18	18	18
July 28	17	19	17	18	19	19	18	16	18	17	17	17	17	17
Mean	18	18	18	18	18	19		18	18	18	19	18	18	

SE±	Sowing date (SD)	Spacing (SP)	SD X SP
1987	0.45	0.55	1.09
1988	0.31	0.47	0.95

Table 2. Effects of sowing date and intra-row spacing on the number of days to first flowering at Samaru in 1987 and 1988.

Date of sowing	1987 Intra-row spacing (cm)							1988 Intra-row spacing (cm)						
	15	20	25	30	35	40	Mean	15	20	25	30	35	40	Mean
June 9	49	49	51	48	51	49	50	57	59	50	52	53	50	53
June 23	49	50	50	49	50	50	49	54	58	53	62	58	51	56
July 12	49	47	47	48	48	47	48	56	53	37	64	43	50	50
July 28	49	47	47	47	48	49	47	49	56	44	60	57	50	53
Mean	48	48	48	48	49	49		54	56	46	59	53	50	

SE±	Sowing date (SD)	Spacing (SP)	SD XSP	Year	SD	SP
1987	0.48	0.58	1.16	1987	NS	NS
1988	3.28	4.01	8.02	1988	*	**

Level of significance
* = 5%
** = 1%
NS = Not significant

Table 3: Effect of sowing date and intra-row spacing on plant height of sunflower at flowering at Samaru, 1987 and 1988.

Date of sowing	1987 Intra-row spacings (cm)							1988 Intra-row spacings (cm)						
	15	20	25	30	35	40	Mean	15	20	25	30	35	40	Mean
June 9	131.2	149.0	145.4	140.6	141.2	138.6	141.0	127.2	137.1	150.4	130.3	129.7	149.8	137.4
June 23	125.3	123.3	124.3	120.0	120.7	126.0	123.3	138.3	141.1	137.9	142.4	127.7	127.6	135.8
July 12	84.4	77.2	89.4	96.1	89.4	87.4	87.3	124.8	133.3	143.3	131.8	138.6	136.4	134.7
July 28	75.1	65.1	69.2	67.0	69.0	72.5	69.7	128.9	122.3	128.1	127.4	125.3	129.8	128.6
Mean	104.2	103.2	107.3	106.2	105.3	106.4		129.8	133.5	139.9	132.9	132.8	135.9	

SE±	Sowing date (SD)	Spacing (SP)	SD X SP	Year	SD	SP	SDXS
1987	2.97	3.64	7.27	1987	**	NS	**
1988	3.09	3.78	7.57	1988	*	NS	NS

Level of significance
* = 5%
** = 1%
NS = Not significant

level of yield is reached which is barely exceeded as density increases further. This constant yield over a wide range of high densities is thought of as representing the maximum fixation of energy the crop can achieve in the time between sowing and harvest. In sunflower, the effect of spacing on growth and yield appears inconclusive. Massey (1971) reported that spacing did not affect plant height or number of leaves but stem diameter increased with wider spacing. He also noted that seed yield decreased but yield per head and head diameter increased with each 15 cm increase in plant spacing. According to Zubriski and Zimmerman (1974), increasing plan density increased seed yield and yield of oil from oil-type sunflower, while it reduced head size and percentage of large size seeds of confectionary cultivars. Also Robinson (1978) found that sunflower grown in rows 56, 76 or 97 cm apart did not differ in seed yield, height or flowering date while Unger (1980) observed that seed yields were not significantly different with plantangs from late March to Mid-June. More recently, Mathers and Stewart (1982) reported that yields were not affected to a large degree by differential row spacings and plant population treatments.

As a newly introduced crop, information is not available on the culture of sunflower as an oilseed in the Nigerian savanna. Since sowing date and intra-row spacing are important factors in determining crop yields, a study was initiated to determine the effect of sowing date and intra-row spacing on grain yield and other plant characteristics of sunflower. The objective of this paper was therefore to relate the effects of sowing date and intra-row spacing on the performance of sunflower under the Northern Guinea savanna ecologial zone of Nigeria.

MATERIALS AND METHODS

Field experiments were conducted for two consecutive years (1987 and 1988) during the rainy seasons at Samaru (11°11'N; 07°38'E) using Isaanka, an open-pollinated variety obtained from Kenya. The treatments included four sowing dates and six intra-row spacings. Sowings were done on the 9th June, 23rd June, 12th July and 28th July in both years. The intra-row spacings used were 15, 20, 25, 30, 35 and 40 cm between hills on ridges spaced 75 cm apart.

The treatments were arranged in a split plot design with the sowing dates occupying the main-plots and the intra-row spacings occupying the sub-plots in three replications in both years. Seeds were overplanted per hill and later thinned to 2 plants per hill two weeks after sowing during the first weeding. Each plot consisted of 4 rows 6 m long. The two middle rows constituted the net plot from which growth measurements and yield records were taken. Fertilizers at the rates of 100 kgN, 50 kg P_2O_5 and 30 kg K_2O per hectare were applied as basic dressing at planting. The field was kept weed-free throughout the trial period by manual weedings.

RESULTS AND DISCUSSION

In 1987 the highest number of leaves per plant was produced when sunflower was sown on July 12. In 1988, however, the highest number of leaves was obtained when sunflower was sown on June 9 (Table 1). The effect of intra-row spacing on the number of leaves per plant was essentially the same in both years. In 1987, the widest intra-row spacing (40 cm) gave the highest number of leaves while in 1988 the highest number of leaves was obtained in the 30 cm intra-row spacing. This result corroborates the findings of Massey (1971), who observed that spacing did not affect plant height or number of leaves. Hence number of leaves per plant is most greatly altered by environmental variations caused by differences in the dates of sowing as well as plant density.

More days were taken before the first flower was produced in 1988 than in 1987 (Table 2). In 1988 the intra-row spacing significantly affected the number of days to first flowering but there was not consistency in the trend. The effect of intra-row spacing on the number of days to first flowering appeared more consistent in 1987, when there was only one day difference throughout the range of the intra-row spacings compared to 1988 where a difference of up to 13 days was observed. Interactions between sowing date and intra-row spacing in both years were not significant.

The sunflower grow taller in 1988 than in 1987 (Table 3). Sowing date significantly affected the height of the sunflower in both years. Early sowing (June 9) was found to result in the tallest plants in both years while the later sowings tended to shorten plant height. In another population, Unger (1980) reported that planting from early May to early June resulted in taller plants than either earlier or later plantings. The trends were however, not consistent. Intra-row spacing did not significantly affect plant height in both years, however, the tallest plants were observed at the 25 cm intra-row spacing. The interaction between sowing date and intra-row spacing was significant only in 1987 when the sowing on June 9 at 20 cm intra-row spacing resulted in the tallest plants.

Table 4: Effect of sowing date and intra-row spacing on sunflower head diameter (cm) at Samaru in 1987 and 1988

Date of sowing	1987 Intra-row spacing (cm)							1988 Intra-row spacing (cm)						
	15	20	25	30	35	40	Mean	15	20	25	30	35	40	Mean
June 9	13.8	12.1	12.8	13.8	13.3	14.7	13.4	13.4	13.9	15.4	14.6	14.4	14.0	14.3
June 23	13.9	12.5	12.5	13.0	14.3	13.1	13.2	14.4	11.6	13.1	14.9	13.8	13.3	13.5
July 12	14.6	14.7	13.7	14.3	14.2	14.7	14.4	14.1	15.1	14.4	14.6	16.5	14.6	14.9
July 28	13.5	13.8	13.8	12.4	13.8	13.2	13.4	10.8	10.2	11.5	11.1	10.9	10.8	10.9
Mean	14.0	13.3	13.2	13.4	13.9	13.9		13.2	12.7	13.6	13.8	13.9	13.2	

SE±	Sowing date (SD)	Spacing (SP)	SD X SP
1987	0.43	0.53	1.06
1988	0.38	0.46	0.93

Year	SD	SP	SDXSP
1987	NS	NS	NS
1988	*	NS	NS

Level of significance
* = 5%
NS = Not significant

The sunflower head diameter was similar in both years. However, it was significantly affected by date of sowing in 1988 (Table 4). Late sowing (July 28, 1988) resulted in smallest heads. Heads were largest for the July 12 planting in both years. Head size was probably influenced by plant population differences whith were not determined, and by natural plant variability (Unger and Thompson 1982). The effect of intra-row spacing on sunflower head diameter was not significant in both years and no definite trend was observed. Tanimu and Ado (1988) observed that head diameter in sunflower depends on other environmental factors especially sowing date, soil fertility, plant population and competition with weeds among others. The interaction between date of sowing and intra-row spacing did not bear significant effect on head diameter.

Table 5: Effects of sowing date and intra-row spacing on sunflower grain yield (kg/ha) at Samaru, 1987 and 1988.

Date of Sowing	1987 Intra-row spacings (cm)						
	15	20	25	30	35	40	Mean
June 9	984.4	914.4	446.7	993.3	1106.1	565.0	835.0
June 23	837.8	1790.4	1602.8	1497.2	1678.9	1168.3	1429.4
July 12	1296.7	1592.2	1807.8	1706.7	1259.4	1228.9	1485.0
July 28	1229.4	733.3	1638.3	1161.7	1032.2	933.3	1139.4
Mean	1114.4	1257.8	1373.9	1345.0	1268.9	973.9	
Date of Sowing	1988 Intra-row spacings (cm)						
	15	20	25	30	35	40	Mean
June 9	642.7	899.0	921.3	932.3	946.3	898.3	873.3
June 23	686.3	940.7	884.3	942.3	890.3	947.0	881.8
July 12	640.0	934.3	913.0	907.0	877.7	928.0	866.7
July 28	639.0	912.7	918.3	916.3	960.3	931.0	879.6
Mean	652.0	921.7	909.3	924.5	918.7	926.1	

SE±	Sowing date (SD)	Spacing (SP)	SD X SP
1987	34.72 *	42.52 *	75.06 **
1988	14.31 NS	17.53 **	35.06 NS

Level of signifikance * = 5%
** = 1%
NS = Not significant

Yields were higher in 1987 than in 1988 (Table 5), eventhough the amount of rainfall recieved in 1988 was higher and wider in distribution than in 1987 (Table 6). The disparity in yield in the two years could be attributed to the distribution of rainfall at the different growth stages of the crop. According to Diepenbrock (1988), sunflower has a remarkably high water consumption given adequate supply of water. Its greatest need for water is during flowering. Under water stress, a crop will reduce its leaf area, but this is also associated with lower yields because there is a close correlation between leaf area at flowering and yield. Thus, eventhough the total rainfall in 1988 was higher than in 1987,

a look at the days of rain reveals that there was less rainfall in 1988 at the flowering stage when compared with 1987. According to Robinson (1978), yield losses are generally greatest when moisture stress occurs in the period from 20 days before to 20 days after flowering. However, Talha and Osman (1975) observed that sunflower was more sensitive to the strees at the slow elongation stage 25 days after planting than at the fast elongation, flowering or ripening stages of growth. It was observed that sowing sunflower from the last week of June to the second week of july generally gave higher grain yields in the Northern Guinea savanna zone of Nigeria. Tanimu *et al.*, (1986) reported high stand count and grain yield of sunflower at Samaru when sown any time between the last week of June and the first week of July while Kaigama *et al.*, (1987) found grain yield to significantly decrease with successive sowing dates (June 30, July, 10 and July 20). In Southern Guinea savanna zone, Ogunremi (1979) reported highest sunflower grain yields when sowing was performed during the third week of May.

In 1987, sunflower sown from 20 to 35 cm between hills gave good yields, although

Table 6: Rainfall distribution (cm) at 10-day intervals in Samaru in 1987 and 1988.

Month	Days	1987	1988
April	1-10	0	0
	11-20	0	26.3
	21-30	0	8.3
May	1-10	0	0
	11-20	0	35.4
	21-31	135.7	59.0
June	1-10	85.1	37.3
	11-20	16.2	17.2
	21-30	45.2	68.7
July	1-10	52.3	50.8
	11-20	106.4	48.2
	21-31	118.0	82.5
August	1-10	105.4	100.4
	11-20	75.2	107.9
	21-31	87.4	194.2
September	1-10	33.0	76.5
	11-20	57.1	71.0
	21-30	12.0	44.8
October	1-10	42.6	114.7
	11-20	0	0
	21-31	0	0
Total		971.6	1153.2

Source: Meteorogical Station Samaru.

the sowing at 25 and 30 cm between hills gave the highest grain yields. In 1988, however, sunflower sown at 15 cm intra-row spacing gave significantly lower grain yield than the other intra-row spacings tested. Massey (1971) observed a decrease in grain yield with reduced intra-row spacing although Zubriski and Zimmerman (1974) observed an increase in grain yield with increase in population density of sunflower. The interaction between date of sowing and intra-row spacing was significant only in 1987, when it was observed that sowing from the last week of June to the second week of July at a distance of 20-35 cm between hills gave the highest yields.

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EFFETS DES DATES DE SEMIS ET DES ESPACES ENTRE-RANGS SUR LE RENDEMENT DU TOURNESOL DANS LA SAVANE NIGÉRIANE.

RÉSUMÉ

Les effets de quatre dates de semis (9 juin, 23 juin, 12 juillet et 28 juillet) et de six espaces entre-rangs (15,20,25,30,35 et 40 cm) sur le rendement du tournesol ont été étudiés pendant deux années consécutives dans la savane nigériane. La date de semis a affecté significativement la hauteur des plantes et la floraison au cours des deux années. La date de semis a eu des conséquences sinificatives sur le rendement en grain en 1987 et le nombre de jours à la première floraison en 1988. L'espace entre rangs a modifié significativement le rendement en grain au cours des deux années et le nombre de jours à la première floraison en 1988. L'interaction entre la date de semis et l'espace entre rangs était significative pour le rendement en grain en 1987 et pour la hauteur des plantes à la seconde semaine de juillet avec un espace entre rangs de 25 à 30 centimétres ont donné les meilleurs rendements en grain.

EFECTOS DE LA FECHA DE SIEMBRA Y EL ESPACIAMIENTO DENTRO DE LA LINEA EN EL COMPORTAMIENTO DEL GIRASOL EN LA SABANA NIGERIANA

RESUMEN

Los efectos de cuatro fechas de siembra (9 de Junio, 23 de Junio, 12 de Julio y 28 de Julio) y seis espaciamientos dentro de la línea (15, 20, 25, 30, 35 y 40 cm) en el comportamiento de girasol fueron estudiados durante dos años en la sabana Nigeriana. La fecha de siembra afectó significaotivamente la altura de la planta en la floración en ambos años. Sin embargo, la fecha de siembra afectó significativamente el rendimiento en 1987 y el número de días de la primera floración en 1988. El espaciamiento dentro de la línea afectó significativamente al rendimiento de ambos años y el número de días a la primera floración en 1988. Las interacciones entre las fechas de siembra y los espaciamientos entre líneas fueron significativas para rendimiento en grano en 1987 y para altura de la planta en floración en 1988. La siembra desde la última semana de Junio a la segunda semana de Julio con espaciamientos entre 25 y 30 cm dió los rendimientos mas altos.