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Effect of irrigation interval, sowing method and farmyard manure on growth and seed yield of faba bean (*Vicia faba L.*) in the desert plain soils of northern Sudan

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ABSTRACT

This study was conducted at the National Institute of Desert Studies (NIDS) Research Farm, on the desert plain soils of the New Hamdab Agricultural Scheme, New Hamdab, Northern State, Sudan, during the winter seasons of 2008/09 and 2009/10. The objectives of the study were to determine the effect of irrigation intervals, sowing methods and farmyard manure on the growth and yield of improved Selaim cultivar of faba bean in a desert environment, and to develop a suitable technical package for these arid areas. A split-split plot design was used with four replicates. The irrigation intervals of 7, 10 and 13 days were assigned to the main plots, the two sowing methods on flat and ridges were assigned to the sub plots while the farmyard manure (FYM) with two rates of 0 and 10 t/ha was assigned to the sub-sub plots. Irrigation intervals had significant effects on number of days to 80% maturity, number of pods/plant, number of seeds/pod, biological yield and seed yield. Sowing methods significantly affected plant population, number of days to 80% maturity and biological yield. On the other hand, FYM application led to significant differences in the number of seeds/pod and number of pods/plant. However, the effects of these factors on the harvest index, 100 seed weight and time to 50% flowering were not significant. The results showed that the best seed yield (3.29 and 2.13 t/ha) was obtained when the irrigation interval was seven days with sowing on flat surface and with the application of 10 t/ha of FYM. This package resulted in the tallest plants, highest number of pods per plant, highest number of seeds per pod and highest seed yield.

INTRODUCTION

Faba bean (*Vicia faba* L.) or broad bean is an important food legume crop in Sudan. It is cultivated under irrigation in the winter season in the Northern and River Nile States. The cultivation is mostly restricted to fertile alluvial soils, which are highly productive and produce good quality seeds. Due to area limitation in the Northern State of Sudan, present and future expansion of agricultural production is targeted to the less productive soils in the high terrace and desert plain soils away from the River Nile bank. Generally, the agronomic practices are very important aspects of crop management. The irrigation intervals, sowing methods and fertilization are considered as fundamental elements of technical packages for crop management in the arid region, which lead to high productivity. The production problems of the crop in the Sudan are manifested in the low yields, poor seed quality, little farmers experience and knowledge about management practices of the crop, and the negative effect of pests and diseases. The aim of this study was to determine the effect of irrigation intervals, sowing methods and FYM on growth and seed yield of faba bean in the desert plain soils, and thereby to develop a suitable technical package for the crop production in this arid area of northern Sudan.

MATERIALS AND METHODS

This study was conducted at the NIDS Research Farm, in New Hamdab agricultural scheme at Northern State, Sudan. The area lies between longitudes 31º 06′ 08″ and 31º 13′ 31″ E and latitudes 17º 55′ 11″ and 17º 58′ 11″ N. The experiment was carried out during seasons 2008/09 and 2009/10.The climate of the area was a typical arid climate, the mean maximum and minimum temperatures were 43.1ºC in June and12.6º C in January, respectively; humidity ranges between 12% and 50%. The soil was described as El Multaga soil series, which is vertic haplocambids, member of fine loamy, mixed, hyperthermic that occurs on the desert plain of El Multaga scheme (Land and Water Research Center, 1999).

The improved Selaim cultivar of faba bean (SM-L) was grown under three irrigation intervals of 7, 10 and 13 days with two sowing methods: on flat surface in rows 60 cm apart and on ridges 60 cm apart and with two levels of farmyard manure: zero and 10 t/ha. A split-split plot design was used with four replicates. The irrigation intervals were assigned to the main plots, (factor A).The two sowing methods were assigned to the sub plots (factor B) while the farmyard manure (FYM) was assigned to the sub-sub plots (factor C).

The cultivar (SM-L) was planted manually on the 5 th and 15 th of November for the two seasons 2008/09 and 2009/10, respectively. Seeds were sown in holes at a spacing of 20 cm with 2 seeds per hole in both sowing methods. The experimental plots received 18 kg N /ha as urea and 36 kgP_2O_5 /ha as super phosphate fertilizer. The FYM was applied before sowing and incorporated manually into the soil. Pests such as the white fly and aphids were controlled successfully using Folimat 800 SL, at the rate of 1.5 ml/l. Weeding was carried out manually for all experimental units, as necessary during the two growing seasons. The crop was irrigated for establishment and then irrigation was carried out according to treatment requirements.

The meteorological data including maximum and minimum air temperatures and wind speed (km/day) for both seasons was obtained from NIDS Meteorological Station near the experimental site.

Five soil samples in the study area were collected randomly before the start of the first season for routine chemical soil analysis**.** The analysis was carried out at the laboratories of Agricultural Research Corporation, Wad Medani.

Measurement of the soil moisture contents (MC) in the root zone (0 -25 cm, 25 -50 cm, 50 -75 cm and 75 -100 cm soil depths) was made gravimetrically before and after each irrigation using augors and ovens. MC(%) was calculated using the following formula:

$$MC(\%) = \frac{WW - DW}{DW} \times 100$$

where:
WW = wet weight of soil sample (g).
DW = dry weight of soil sample (g).

Then the total moisture applied at each irrigation was calculated using Michael's (1978) formula to convert to volumetric values as follows:

$$S= G.D\,(M_1 - M_2)\,/100$$

where:
S= change in soil moisture storage (mm).
G = bulk density (g cm^{-3}).
D = soil depth (cm).
M_1= initial moisture content (%) before irrigation.
M_2= final moisture content (%)after irrigation

Plant height (cm), days to 50% flowering, percentage of flowers drop, days to 80% maturity, percentage of pod drop, plant population, number of pods per plant, number of seeds per pod, seed yield, biological yield, hundred seed weight and harvest index were determined.

Standard analysis of variance for the split-split plot design using MSTAT statistical computer package of Michigan University was used to analyze data and Duncan Multiple Range Test (DMRT) was used for means separation**.**

RESULTS AND DISCUSSION

Air temperature and wind speed

The mean maximum temperatures (32°C) was similar for both seasons, but the monthly distribution of maximum temperatures was different between seasons where the temperature was higher in November and December of the first season and lower in January , February and March compared to the second season.

The mean minimum temperature in the first season was higher (12.8° C) than that of the second season (10.4° C). The monthly distribution of temperature showed consistently lower temperatures in the second season compared to the first season. The mean wind speed in the 2nd season (183 km/day) was higher than that of the 1st season (170 km/day), Table (1).

Table 1. Mean monthly air temperatures and wind speed of the experimental site for both seasons.

Month	Maximum temperature (°C)		Minimum temperature (°C)		Wind speed (km/day)	
	First season	Second season	First season	Second season	First season	Second season
November	34	33	16	13	149	221
December	31	28	13	07	170	153
January	30	31	10	09	147	163
February	32	33	12	10	173	174
March	34	35	13	13	211	206
Mean	32	32	12.8	10.4	170	183

Chemical properties of the soil of the experimental site

Chemical analysis of the soil of the experimental site prior to the execution of the experiment showed that the soil was non-saline (ECe 0.4 dSm^{-1}), non-sodic (ESP 3%) and alkaline (pH 7.9). It also showed that the soil is deficient in nitrogen (0.027%), available phosphorus (3 mg kg^{-1}), potassium (0.79 $cmol^{(+)}$ kg^{-1}soil), organic carbon (0.12 %) and cation exchange capacity (34 $cmol^{(+)}$ kg^{-1}soil).

Soil moisture content

The results in Table 2 revealed that the highest amount of water applied in the root zone was 972 and 950 mm for the first and second seasons, respectively, recorded for the treatments irrigated every seven days, sown on ridges and with the addition of 10 t/ha of FYM. On the other hand, the lowest amount of water applied across seasons was 506 mm to the crop irrigated every 13 days, sown on flat surface and with the addition of 10 t/ha of FYM.

Seed yield in the 1st season was higher than that of the 2nd season; this may be attributed to the flower and pod drop in the second season which was higher than that of the first season. The highest seed yields of 3.29 t/ha and 2.13 t/ha were obtained in the first and second seasons, respectively, by the crop irrigated at an interval of seven days and sown on flat surface and with the addition of 10 t/ha of FYM. This crop used 891 mm, (Table2). These results were in agreement with those obtained by Erneo *et al*.(2003) who reported the highest seed yields of 3.545 and 2.631 t/ha in the first and second seasons, respectively, at the Selaim basin.

Generally, across treatments mean of applied water at the active root zone was 666 mm across seasons, more than the value of 430 mm reported by Salih *et al.* (1995) at Hudieba and measured by a neutron probe.

Table 2. Effects of treatments on water applied at the active root zone and seed yield of faba bean for seasons 2008/09 and 2009/10 and combined over two seasons.

Treatments	Water applied (mm)season			Seed yield(t/ha)		
	First season	Second season	Combined	First season	Second season	Combined
$Trt_1(A_1 B_1C_1)$	651.36	884.78	734.73	2.88	1.78	2.33
$Trt_2(A_1 B_1C_2)$	859.56	925.76	891.13	3.29	2.13	2.68
$Trt_3(A_1 B_2C_1)$	554.88	723.80	652.84	2.63	1.40	2.01
$Trt_4(A_1 B_2C_2)$	972.00	950.40	961.21	2.97	2.08	2.55
$Trt_5(A_2 B_1C_1)$	649.17	632.56	640.79	2.71	1.85	2.26
$Trt_6(A_2 B_1C_2)$	491.04	780.32	635.68	2.95	1.85	2.40
$Trt_7(A_2 B_2C_1)$	443.97	808.00	625.40	2.93	1.70	2.33
$Trt_8(A_2 B_2C_2)$	471.87	806.96	639.43	2.71	1.38	2.05
$Trt_9(A_3 B_1C_1)$	448.07	645.60	546.98	2.89	1.55	2.23
$Trt_{10}(A_3 B_1C_2)$	530.39	480.60	505.78	2.44	1.10	1.76
$Trt_{11}(A_3 B_2C_1)$	387.41	708.42	547.91	1.77	1.10	1.44
$Trt_{12}(A_3 B_2C_2)$	560.70	657.60	609.33	2.14	1.13	1.64
Mean	585.04	672.87	665.93	2.69	1.59	2.15
SE±	31.74	79.77	61.33	0.21	0.21	0.24

A_1 =irrigation interval of 7 days, A_2= irrigation interval of 10 days, A_3= irrigation interval of 13 days, B_1= 1st sowing method (rows on flat), B_2= 2nd sowing method (on ridges), C_1= zero t/ha of FYM, C_2=10 t /ha of FYM and SE± standard error.

Number of days to 50% flowering

Irrigation intervals, sowing methods and FYM showed no effects on number of days to 50% flowering for both seasons or combined (Table 3). This result agrees with that of Hawtin and Webb (1982) who reported that water stress did not affect time to the appearance of the first flower buds, and agrees with the results obtained by Salih (1988) who reported that irrigation had no effect on days to 50% flowering and confirmed those of Babiker (1975) and Ayoub (1971) who obtained similar results in their studies on the effect of different fertilizers on faba bean. The mean number of days to 50% flowering varied from 49 to 54 days with an average of 52 days for both seasons, (Table 3).

Number of days to 80% maturity

The mean number of days from planting to 80% maturity ranged between 110 to 116 days for both seasons (Table 3). The results showed significant differences ($p \leq 0.05$) in the number of days to 80% maturity between the irrigation intervals for both seasons and combined over two seasons. The highest number of days to 80% maturity was 116 days obtained with the irrigation interval of seven days in the second season (Table 3). The lowest number of days was obtained for crops irrigated every ten days and thirteen days for the first and the second seasons, respectively. This may be attributed to the stress encountered by the long irrigation interval treatments. A significant difference ($p \leq 0.05$) was shown in the first season and combined over two seasons for the effect of sowing methods on number of days to 80% maturity. There was no significant effect on the number of days to 80% maturity due to FYM application (Table 3). This may be attributed to the fact that faba bean is a legume crop capable of nitrogen fixation. The interaction between irrigation intervals and FYM (AC) showed significant differences ($p \leq 0.05$) in the number of days to 80% maturity in the first season only (Table 3).

Table 3. Effects of irrigation intervals, sowing methods and

FYM on numbers of days to 50% flowering and days to 80% maturity of faba bean for both seasons and combined over two seasons.

Treatments	No. of days to 50% flowering			No. of days to 80% maturity		
Irrigation interval (A)	First season	Second season	Combined	First season	Second season	Combined
7	49	52	50	113	116	115
10	52	53	52	110	115	113
13	54	53	53	112	111	112
SE±	2.51 Ns	1.00 Ns	1.35 Ns	0.56*	0.69*	0.45*
Sowing methods(B)						
Flat	51	53	52	110	113	112
Ridges	52	52	52	113	115	114
SE±	2.28 Ns	2.31 Ns	1.35 Ns	0.52*	0.78 Ns	0.32**
FYM (C)						
0 t/ha	51	52	52	112	115	113
10 t/ha	52	52	52	112	114	113
SE±	2.28 Ns	1.46 Ns	1.35Ns	0.29 Ns	0.28 Ns	0.32NS
Mean	51	52	52	112	114	13
Interactions						
AB	Ns	Ns	Ns	Ns	Ns	Ns
AC	Ns	Ns	Ns	*	Ns	Ns
BC	Ns	Ns	Ns	Ns	Ns	Ns
ABC	Ns	Ns	Ns	Ns	Ns	Ns
C.V(%)	17.7	13.7	17.96	1.27	1.21	1.94

C.V≡ coefficient of variation(%). SE±≡ standard error.
* Sig. (P≤0.05). **Highly sig. (P≤ 0.01).
Ns ≡ not significant.

Plant height

Figure 1 shows the variation in the mean plant height as a result of different water regimes, sowing methods and FYM. The tallest plants were obtained with the package including irrigation every seven days, sowing on flat surface and with the addition of 10 t/ha of FYM. This result agrees with Erneo *et al.* (2003) who reported that the irrigation interval had a highly significant effect on plant growth, as measured by plant height.

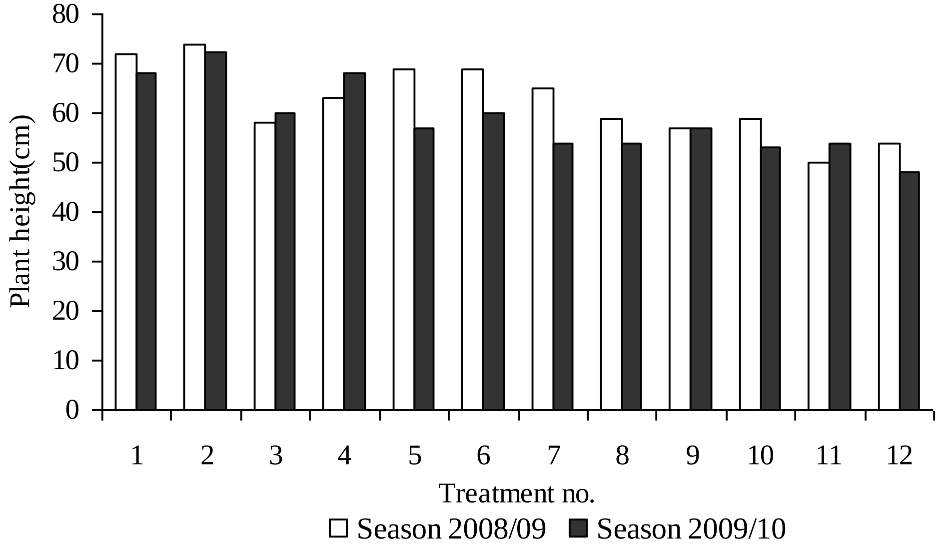

Fig. 1. Effect of treatments on plant height (cm), seasons 2008/09 and 2009/10.

Flower and pod drop (%)

Figure 2 shows that the highest flower drop percentages for both seasons were 60% and 64% obtained for crops which were irrigated every 13 days, sown on ridges and grown without FYM , while the lowest flower drop was recorded for the crop which was irrigated every seven days and sown on ridges with the addition of 10 t/ha of FYM. The higher shedding percentage may be attributed to the harsh environmental conditions that resulted from the long irrigation intervals, and lack of FYM.

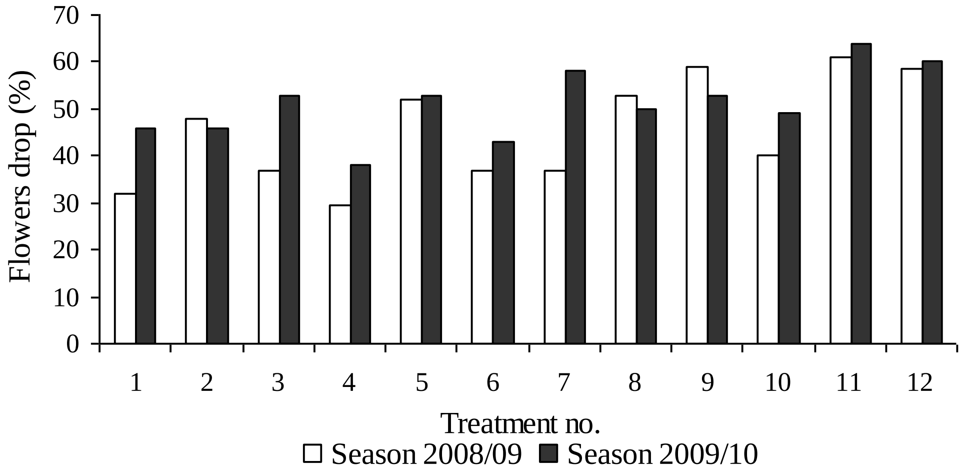

Fig.2. Effect of treatments on flower drop (%), seasons 2008/09 and 2009/10.

Figure 3 shows that the lowest pod drop percentages (32% and 60%) for the first and second seasons, respectively, occurred when the crop was sown on flat surface, without the addition of FYM and irrigated every seven days. The highest pod drop values (46% and 74%) were obtained when the crop was irrigated every 13 days, without FYM and sown on ridges (in the first season) or on flat surface (in the second season), respectively.

Generally, in the second season the flowers and pods drop was higher than that for the first season. This can be attributed to the environmental conditions such as air temperature and wind speed between the two seasons. However, Eltobgy and Ibrahim (1968) reported that shedding of buds, flowers and pods might be considered as a natural phenomenon. This does not rule out the possible effect of the different environmental conditions.

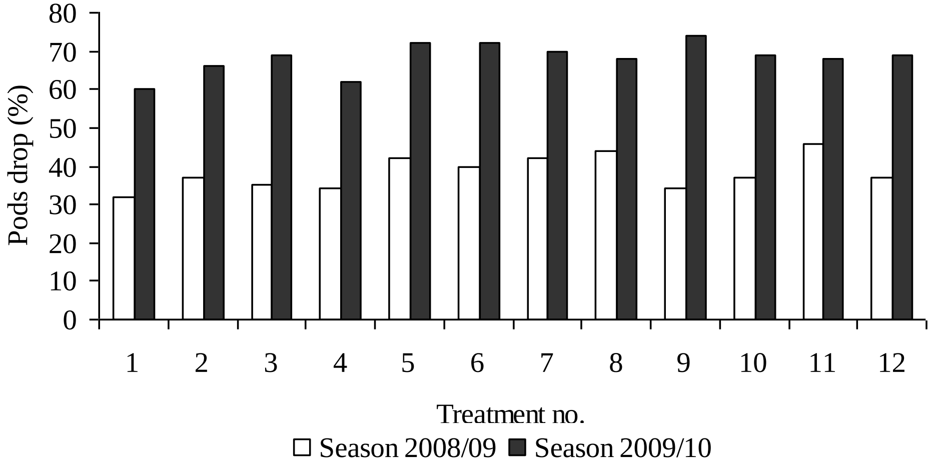

Fig. 3. Effect of treatments on pods drop (%), seasons 2008/09 and 2009/10.

Number of pods per plant

The effect of irrigation intervals on the number of pods per plant was significant ($p \leq 0.05$) in the first season and highly significant ($p \leq 0.01$) in the second season and combined over two seasons. As an average for both seasons, irrigation every seven days increased the number of pods by 29.4% over the ten days irrigation interval and by 41.2% as an average over the 13 days irrigation interval for both seasons (Table 4). This is in line with the results of Salih (1987) who reported significant effects of irrigating every seven days over 14 days on the number of pods/ plant. No significant differences resulted from sowing methods for both seasons (Table 4). The FYM had a significant ($p \leq 0.05$) effect in the first season and in the combined over two seasons on the number of pods per plant. Significant differences ($p \leq 0.05$) in the number of pods per plant were obtained in both seasons and in the combined over two seasons due to the effect of interactions between irrigation intervals, sowing methods and FYM and the interactions between irrigation intervals and sowing methods (Table 4).

Number of seeds per pod

The mean number of seeds per pod ranged between 2.7 to 3.5. The result showed that there were significant differences ($p \leq 0.05$) due to irrigation intervals in the second season and in combined over the two seasons. The irrigation interval of seven days increased seeds per pod by 2.9% (for the first season) and 13.8% (for the second season) over the ten days interval and by 9.3% and 22.2% over the 13 days irrigation interval for the first and second seasons, respectively (Table 4). This agrees with the results of Salih (1985) who reported that watering every 7 days significantly increased number of seeds per pod by 7.5% compared to the 14 day irrigation interval. However, there were no significant differences due to sowing methods on the number of seeds per pod. Significant differences were detected on the number of seeds per pod due to FYM application in the first season and in combined over two seasons. The interaction between irrigation intervals and FYM resulted in significant differences in the number of seeds per pod in the first season and in combined over two seasons (Table 4).

100 seed weight (g)

No significant effect was detected on the hundred seed weight (g) due to different irrigation intervals, sowing methods or FYM application for both seasons (Table 5). This is in contrast to the results obtained by Erneo, *et al.* (2003) who reported that highly significant differences ($p \leq 0.01$) were found on 100 seed weight due to different irrigation intervals, and Salih (1988) who reported that irrigation at 7 days interval resulted in significant increase in the 100 seed weight.

Table 4. Effects of irrigation intervals, sowing methods and FYM on number of pods per plant and number of seeds per pod of faba bean for both seasons and combined over two seasons.

Treatments	No. of pods /plant			No. of seeds /pod		
Irrigation interval (A)	First season	Second season	Combined	First season	Second season	Combined
7	17	8	13	3.5	3.3	3.3
10	12	6	9	3.4	2.9	3.2
13	10	5	8	3.2	2.7	2.8
SE±	1.16*	0.35**	0.61**	0.10 Ns	0.14*	0.08*
Sowing methods(B)						
Flat	13	7	10	3.4	3.0	3.2
Ridges	13	7	10	3.3	2.9	3.1
SE±	0.82 Ns	0.34 Ns	0.42 Ns	0.08 Ns	0.10 Ns	0.0.6 Ns
FYM (C)						
0 t/ha	10	6	9	3.3	2.9	3.0
10 t/ha	14	7	10	3.5	3.0	3.2
SE±	0.76*	0.27 Ns	0.42*	0.04*	0.07 Ns	0.05*
Mean	13	7	10	3.4	3.0	3.1
Interactions						
AB	Ns	*	*	Ns	Ns	Ns
AC	Ns	Ns	Ns	*	Ns	*
BC	Ns	Ns	Ns	Ns	Ns	Ns
ABC	*	Ns	*	Ns	Ns	Ns
C.V(%)	28.4	20.6	29.67	6.9	11.4	12.60

C.V≡ coefficient of variation(%). SE±≡ standard error.
* Sig. (P≤0.05). ** Highly sig. (P≤ 0.01).
Ns ≡ not significant.

Plant population

The mean plant population per square meter ranged from 17 to 20 for both seasons. There were no significant differences (p≤0.05) due to various irrigation intervals or FYM on the plant population which was recorded after two weeks from planting, (Table 5). This is in agreement with the results obtained by

Salih (1992) who reported that irrigation had no effect on plant population. The effect of sowing methods on plant population showed highly significant differences ($p \leq 0.05$) in the first season and in combined over two seasons, (Table 5). There were no significant differences ($p \leq 0.05$) in plant population resulting from treatment interactions in both seasons (Table 5).

Seed yield

The average seed yield across treatments ranged from a lowest value of 1.21 to a highest of 2.95 t/ha with overall mean values of 2.69 and 1.59 t/ha for the first and the second seasons, respectively. The results revealed significant differences ($p \leq 0.05$) in the first season (2008/09) and highly significant differences ($p \leq 0.01$) in the second season (2009/10) due to irrigation intervals. The irrigation interval of seven days increased seed yield by 12.7% (for the first season) and 18.75 % (for the second season) over the ten days interval and by 27.7% and 57.0% over the 13 days irrigation interval for the first and second seasons, respectively (Table 6). These results confirmed the results of Ayoub (1972) at Hudeiba Research Station who found that the irrigation interval of 8 days increased grain yield by 22%, 63% and 108% over 13, 18 and 23 days intervals, respectively. The results also confirmed those obtained by Babiker (1975) who reported that irrigating faba bean at weekly intervals increased grain yield by 92% over irrigating every two weeks at Hudeiba.

In this study, neither sowing methods nor FYM had an effect on the seed yield in both seasons (Table 6). The interaction between irrigations and FYM, (AC) resulted in significant differences ($p \leq 0.05$) in the second season only (Table 6).

Table 5. Effects of irrigation intervals, sowing methods and FYM on 100 seed weight and plant population of faba bean for both seasons and combined over two seasons.

Treatments	100 seed weight (g)		Plant population (m^2)		
Irrigation interval (A) (days)	First season	Second season	First season	Second season	Combined
7	57.6	58.8	18	20	19
10	57.1	58.1	19	20	19
13	57.2	54.3	19	20	19
SE±	0.32 Ns	1.29 Ns	0.61Ns	0.04 Ns	0.31Ns
Sowing methods(B)					
Flat	57.0	57.6	20	20	20
Ridges	57.5	56.6	17	20	19
SE±	0.89 Ns	0.60 Ns	0.56**	0.03 Ns	.18**
FYM(C)					
0 t/ha	57.8	57.2	19	20	19
10 t/ha	56.8	56.9	19	20	19
SE±	0.60 Ns	0.53 Ns	0.16 Ns	0.48 Ns	0.18Ns
Mean	57.29	57.06	19	20	19
Interactions					
AB	Ns	Ns	Ns	Ns	Ns
AC	Ns	Ns	Ns	Ns	Ns
BC	Ns	Ns	Ns	Ns	Ns
ABC	Ns	Ns	Ns	Ns	Ns
C.V(%)	5.1	4.6	4.17	1.18	6.36

C.V≡ coefficient of variation (%). SE±≡ standard error. * Sig. (P≤0.05). ** Highly sig. (P≤ 0.01).
Ns ≡ not significant.

Biological yield

The mean biological yield across treatments ranged between 3.3 and 12.1 t/ha for both seasons. The results revealed a significant effect of irrigation intervals on the biological yield of faba bean (p≤0.05) in the first season and highly significant differences (p≤0.01) in the second season, respectively. Irrigation every seven days increased the biological yield by

19.8% and 10.4 % over irrigation every ten days and by 34 and 60% over irrigation every 13 days for the first and second seasons, respectively (Table 6). This is in line with the results of Korgman *et. al.* (1980) who reported that total biomass varied with irrigation frequency.

The effect of sowing methods on the biological yield resulted in highly significant differences ($p \leq 0.01$) in the second season only, (Table 6). There were no significant differences due to the effect of FYM on the biological yield in both seasons. The effects of interactions between irrigation interval and FYM (AC) and between sowing methods and FYM (BC) were significant ($p \leq 0.05$) for the second season only, Table (6).

Harvest index (%)

The result showed that the irrigation interval, sowing methods and FYM had no significant effect on the harvest index of faba bean in both seasons, (Table (6). This agrees with the results of Korgman *et. al.* (1980) who reported that both seed yield and total biomass varied with irrigation but harvest index remained constant.

Table 6. Effects of irrigation intervals, sowing methods and FYM on seed yield, biological yield and harvest index of faba bean for both seasons.

Treatments	Seed yield (t/ha)		Biological yield (t/ha)		Harvest index (%)	
Irrigation interval (A)	First season	Second season	First season	Second season	First season	Second season
7	2.95	1.90	12.1	5.3	25	40
10	2.63	1.60	10.1	4.8	30	41
13	2.31	1.21	09.0	3.3	26	40
SE±	0.16*	0.07**	0.53*	0.19**	1.35 Ns	1.12 Ns
Sowing methods(B)						
Flat	2.86	1.71	10.7	5.1	27	38
Ridges	2.53	1.46	10.2	3.8	27	43
SE±	0.15 Ns	0.09 Ns	0.44 Ns	0.16**	0.94 Ns	2.40 Ns
FYM (C)						
0 t/ha	2.63	1.57	10.3	4.6	27	40
10 t/ha	2.75	1.61	10.6	4.4	27	40
SE±	0.09 Ns	0.09Ns	0.44 Ns	0.13Ns	0.79 Ns	1.27 Ns
Mean	2.69	1.59	10.4	4.5	27	40
Interactions						
AB	Ns	Ns	Ns	Ns	Ns	Ns
AC	Ns	*	Ns	*	Ns	Ns
BC	Ns	Ns	Ns	*	Ns	Ns
ABC	Ns	Ns	Ns	Ns	Ns	Ns
C.V(%)	15.91	26.37	20.83	15.40	14.3	15.4

C.V≡ coefficient of variation (%). SE±≡ standard error.
* Sig. (P≤0.05). **Highly sig. (P≤ 0.01).
Ns ≡ not significant.

CONCLUSIONS

This study revealed that irrigation interval had significant effects on the number of days to 80% maturity, number of pods per plant, biological yield and seed yield. The results also showed significant differences in the plant population, number of days to 80% maturity and biological yield due to sowing methods effects. On the other hand, FYM application led to significant differences in the number of seeds per pod and number of pods/plant. The effects of these factors (irrigation intervals, sowing methods and FYM) on the harvest index, 100 seed weight and time to 50% flowering were not significant. The package which consisted of seven days irrigation interval, sowing on flat surface and application of 10 t/ha of FYM, recorded the highest number of pods per plant, highest number of seeds per pod, tallest plants and highest seed yield.

RECOMMENDATIONS

Based on the results of this experiment and to obtain the maximum possible seed yield of faba bean from the desert plain soils of northern Sudan, the authors recommend the adoption of the package consisting of the seven days irrigation interval, sowing on flat and the application of 10t/ha of FYM.

REFERENCES

Ayoub, A.T. 1971. *Ful masri* (broad bean) fertilizer experiment. Annul Report 1971-72, Hudeiba Research Station, Ed Damer, Sudan.

Ayoub, A.T. 1972. Seed yield and seed hardness of two *Full masri* variety. Annual report 1972-1973, Hudeiba Research Station, Ed Damer, Sudan.

Babiker, I.A. 1975. *Full masri* (broad bean) nitrogen, phosphate application and watering interval. Annual Report 1974-75, Hudeiba Research Station, Ed Damer, Sudan.

El Tobgy, H.A. and A.A. Ibrahim. 1968. A comparative study of some local and imported varieties of bean (*Vicia faba*).I. Flowering. Agricultural Research Review 46, 12-28.

Erneo, D. Balasio, A. Hussein and M.A. Ahmed. 2003. Effect of watering regimes on growth and grain yield of faba bean (*Vicia faba*) at Selaim basin. Sudan Journal of Agricultural Research. 16:43-45.

Hawtin, G. and C. Webb. 1982. Faba bean improvement. Proceedings of the Faba Bean Conference held in Cairo, Egypt, Martinus Nijhoff Publishers for the International Center for Agricultural Research in Dry Areas (ICARDA)

/IFAD Nile Valley project.

Korgman, K.K, R.C. Mckenzie and E.H. Hobbs. 1980. Response of faba bean yield, production and water use to irrigation. Canadian Journal of Plant Science 60:91-96.

Land and Water Research Centre.1999. Detailed soil survey and land suitability classification of El Multaga Scheme. Merowi Dam Project Implementation Unit, Ministry of Energy and Mining. Ministry of Agriculture and Forestry, Agricultural Research Corporation (ARC), Land and Water Research Center (LWRC), Wad Medani, Sudan.

Michael, A.M. 1978. Irrigation Theory and Practice .VIKAS Publishing House, New Delhi, India.

Salih, F.A. 1985. Varietal performance of faba bean under two different watering intervals. FABIS Newsletter 13:16-17.

Salih, F.A. 1987. Effects of sowing date, irrigation, weed control and methods of planting on faba bean and its components in the Khartoum area of Sudan. Beitrage Zur Tropischen Landwirtschaft und veterinaermedizin 25 H.1, 39-44.

Salih, F.A. 1992. Effects of watering intervals and hill planting on faba bean seed yield and its components. FABIS Newsletter 31: 17-20.

Salih, H. S., O. A. Ageeb and M.C.Saxena.1995. Production and improvement of cool - season food legumes in Sudan. Proceedings of the National Research Review Workshop, Agricultural Research Corporation, Wad Medani, Sudan.

ثر فترات الري وطرق الزراعة والسماد البلدي علي نمو وإنتاجية الفول H في تربة السهل الصحراوي بشمال السودان المصري

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الخلاصة

تمت زراعة الفول المصري صنف سليم المحسن تحت ظروف المناخ الجاف في تربة السهل الصحراوي بشمال السودان في الموسم الشتوي 2009/2008 و2010/2009 بمزرعة المعهد القومي لدراسات الصحراء بمشروع الحامداب الجديدة الزراعي ، الذي يقع علي خطي عرض″11 ′55 °17 و″11 ′58 °17 ش وخطي طول ″08 ′06 °31 و″31 ′13 °31 ق. أجريت هذه الدراسة لتقويم اثر فترات الري وطرق الزراعة والسماد البلدي علي نمو وإنتاجية الفول المصري في تربة السهل الصحراوي. نظمت المعاملات إحصائيا باستخدام تصميم القطع المنشقة المنشقة بأربعة مكررات حيث وضعت فترات الري (7- 10- 13 يوم) في القطع الرئيسية و طريقة الزراعة (ارض مسطحة و سرابات) في القطع الثانوية ومستويا السماد البلدي (صفر و10 طن /للهكتار) في القطع تحت الثانوية. تم حساب المحتوي الرطوبي للتربة ومؤشرات النمو ومكونات الإنتاجية وإنتاجية الحبوب والإنتاج الحيوي ودليل الحصاد. أظهرت نتائج التحليل الإحصائي وجود فروق معنوية لأثر الري علي عدد الأيام حتى 80% نضوج ولعدد القرون في النبات والإنتاج الحيوي وإنتاجية الحبوب، أما طرق الزراعة فأثرت معنويا في الكثافة النباتية وعدد الأيام ل80% نضوج والإنتاج الحيوي ، بينما الأثر المعنوي لاستخدام السماد البلدي كان في عدد الحبوب في القرن وعدد القرون في النبات. أوضحت النتائج أيضا عدم وجود فروق معنوية لفترة الإزهار حتى 50% ودليل الحصاد ووزن المائة حبة. أوضحت الدراسة أن الري كل سبعة أيام وزراعة المحصول على ارض مسطحة وإضافة عشرة طن من السماد البلدي للهكتار هي الأفضل في زراعة الفول المصري في أراضى السهل الصحراوية حيث أدت إلي أفضل طول للنبات وأعلي عدد للقرون في النبات وللحبوب في القرن وبالتالي اعلي إنتاجية للحبوب بلغت 3.29 و2.13طن/ هكتار في الموسمين علي التوالي. عليه يوصى باستخدام هذه الحزمة لزراعة الفول فى اراضى السهل الصحراوى.