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The Effect of Agricultural Practices on Growth and Yield of Black Mahlab (*Monechma ciliatum*)

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Abstract

Field trial was initiated to investigate the effect of sowing date and plant spacing on growth and yield of Black mahlab (*Monechma ciliatum)* so as to determine the optimum sowing date and appropriate plant spacing under the prevailing environmental conditions of Khartoum State. The field experiment involved a factorial combination of 4 plant spacing 10, 20, 30 and 40cm) with three sowing date. Data collected for vegetative growth included the number of days to 50% emergence, plant height, number of leaves, and number of branches per plant, fresh and dry weight per plant. Data for reproductive growth included number of days to 50% flowering, number of fruits per plant, weight of 1000 seeds and seed yield per feddan. All data were statistically analyzed. Results indicated that emergence (days to 50%) in the first sowing date (Autumn) was earlier than the second sowing date (Winter) and the third sowing date (Summer), and days to 50% flowering were less in late than early sowing dates. Also vegetative growth and seed yield were affected by sowing date and plant spacing. Autumn sowing gave higher values among plant spacing compared with Winter and Summer. Plant spacing had significant effect on vegetative as well as seed yield. Values were higher with wider than closer plant spacing i.e. plant at 40×40cm gave the highest values followed by 30×30cm, 20×20cm and 10×10cm. Seed oil content was affected by early sowing date. Higher values were associated with Autumn compared with Winter and Summer.

Keywords

Fragrance, Magician, Dandruff

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1. Introduction

Black mahlab is a famous medicinal plant in Western Sudan, especially in Gabel Mara Area. It seeds are used as an effective laxative, and contain an essential oil which emits a sweet and pleasant odor. It's further used in traditional Sudanese fragrances, lotion and other cosmetics used for wedding preparations and childbirth.

The importance of black mahlab as medicinal plant which is used to relieve abdominal pain, and use as a laxative drug is one of the secrets which were hidden behind folk medicine practitioners.

In spite of its above mentioned values, this plant species which belongs to the family Acanthaceae still grows as a wild plant in valleys. No research data on the cultural practices for its commercial production are available in the Sudan.

Black mahlab (*Monechma ciliatum*) belongs to the Family Acanthaceae. It is an annual hispid scabrous or almost glabrous herb, 30-65cm. high woody below. Leaves are linear or narrowly linear-lanceolate, up to 10cm. long, (1.25cm.) broad (Massey, 1929). Flowers are cream-white with purple and orange stracks, 2-lipped, in short spikes;

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bracts pectinate with long stiff white bristle, lanceolate, leafy, about (1.25cm.) long. Seed with atuft of rigid thick hairs at the hilum, and similar tuft at the other end (Andrews, 1952).

Monechma is one of the useful odour plants in nomadic area of Western Sudan. It has a pleasant aromatic odour which is very important component of heavy Sudanese traditional fragrance like "Karkar oil" or as lotion e.g.; Dilka". It is very effective as a medicinal plant for remedies to stomach disturbance and as a carminative for children.

According to Show (1973) *Monechma ciliatum* is approximately a native of tropical Africa and sometimes India. It is widely distributed from Senegal to Cameroon and eastward to the central and southern provinces of the Sudan and south through East Africa and Zambia (Wickens, 1976). It is also grown in Nigeria (Uguru, 1998).

In the Sudan *Monechma ciliatum* was found to grow widely in Kassala State (Galabat), Southern Blue Nile State (Jongol post); Kordofan State (Elobeid); Upper Nile State, Goz Elsiada, Bahr Elghazal State (Jur-Jachalles) and Bahr Eljebel (Madi).

A cording to Show (1973) and Wickens (1976) this plant is a tropical plant and widely distributed in tropical zones in Africa and India. For that, it requires a worm climate for best vegetative growth. The crop has been found to be grown in coal season.

Monechma sp is one of the important plants in Western Sudan culture. It has a cosmetic and nutritional value. The oil is used to manufacture traditional fragrance and lotion. The plant has a medicinal importance as a laxative medicine to remedy stomach troubles and also used to control scale dandruff which form on the skin in case of oily hair. In Botswana, they believed that Monechma played an important role as a medicine for remedy of General body pain, Liver and bowel trouble (diarrhea), and Sterility in women. (Hedberg and Stengard, 1989). The therapeutic potentials of the herb, black mahlab have been studied by researchers such as (Abdelmoneum, 2008) and (Uguru and Evan 2002). The seeds of plant contain hydrocarbons and fatty acids as stated by Ayoub. Mariod *et al* (2009), screened the seeds chemically, they found fatty acids (palmitic, stearic, linoleic); tocopherols; protein and elements (K, Ca, Mg, Al, Pb, Ni, Mn, Cu, Cr, Co, and Fe). Recently, the seeds were screened by Oshi, *et al* (2010), they detected flavonoids, tannins, triterpens, and anthraquinones.

The broad objective of this study therefore, was to establish the optimum management practices needed for its cultivation as a crop under irrigation and determination of the oil content of the seeds. The specific objective comprised the determination of the optimum planting date, and plant spacing. Moreover, the effect of planting date, and plant spacing on the oil content of the seeds was investigated under the prevailing environment of the Central Sudan.

2. Materials and Methods

Three field experiments were carried out, in the Demonstration Farm of the Department of Horticulture Faculty of Agriculture at Shambat, (Latitude 15º 40´ N and Longitude 32º 32´ E). The climate of the experimental site is semi-arid, tropical with seasonal (July–September) annual rain of 150–180mm. During the Winter the mean minimum temperature is as low as 5ºC and the mean maximum temperature is as high as 48ºC during the Summer.

The Physicochemical analysis of soil by Elhassan (1988), showed that the soil was of clay loamy type with high content of clay, slightly alkaline with pH of 7.5-7.7

Seeds of Black mahlab were obtained from Zalingei in Western Darfur State.

Three field experiments were carried out to study the effect of sowing date and population density on growth and seed yield of Black mahlab plants. Experiments were laid out in a randomized complete block design with four replications.

The numbers of days from planting 50% emergence and to 50% flowering were recorded for each sowing date. Four weeks from planting a sample of five plants from each plot were taken randomly and the mean height, number of leaves per plant, number of branches per plant, and fresh and dry weight per plant were determined. Weeding was done at 3 and 6 weeks after sowing. Thinning was done 2 weeks after sowing.

Successive harvesting was done before fruits reached shattering stage. Number of fruits was counted on each occasion and fresh weight obtained to determine yield. The vegetative parameters assessed included plant height, number of branches, number of leaves and. At final harvest, the okra plants were partitioned into leaves, stem, root and pods and oven-dried in brown envelopes for 48 hours at 80°C. Dry weight measurements were taken of stem, leaves, root and fruits and the total dry weight were calculated by addition.

The data collected were subjected to analysis of variance and the mean differences were compared using LSD at 5% level of significance and standard error.

Total oil content of the seed was determined according to Calmen (1970), as follows:

Finely ground seeds were extracted by petroleum ether (60–80ºC) in continuous soxhelt extracting apparatus. The ground sample (20g) was accurately weighted in an empty thimble of known weight plugged with a piece of cotton wool then the

thimble with the materials was placed in soxhelt extractor.

A dry and accurately weighted round bottom flask was fitted to the extractor, then petroleum spirit was poured into the flask until it fitted approximately two third of the flask.

The flask, the extractor and the condenser were fitted together. Water was allowed to flow through the condenser and heat was applied from an electric heater. Extraction was continuoued for 4–6 hours.

The apparatus was carefully dismounted and the solvent in the flask was evaporated to dryness in air.

2.1. Number of Days to 50% Emergence and 50% Flowering

Emergence percentage was highest for seed sown in Autumn Followed by Winter and Summer (7, 8 and 9 days). 50% flowering range from 53 to 64 days. Summer plant reaches 50% flowering first followed by Winter and Autumn. (Table 1).

2.2. Effect of Sowing Dates and Plant Spacing on Vegetative Growth Parameters

Data presented in Table 2 shows that the differences in plant height were highly significant (p = 0.01) among different sowing dates, however, Autumn sowing date produced taller plants, followed by Winter and Summer. The differences in plant height were highly significant among the four spacing. The longer plants resulted from the closer spacing (10cm) and the shortest ones from the wider spacing. All interactions between factors studied were highly significant (p = 0.01) Table 2.

Table 1. Effect of sowing date on the number of days to 50% emergence and 50% flowering.

Sowing date	No. of days to 50% emergence	No. of days to 50% flowering	First flowering
1st Sept. 2001	7	64	10th Nov. 2001
1st Nov. 2001	8	54	13th Dec. 2001
1st Mar.2002	9	53	16th Apr. 2002

* Significant at 0.05, **: significant at 0.01 and no star means not significant

Table 2. The effect of sowing date and plant spacing (S) on plant height (cm).

Plant Height														
4 weeks						4 weeks					4 weeks				
Seasons	Spacing				means	Spacing				means	spacing				means
	10	20	30	40		10	20	30	40		10	20	30	40	
Autumn	78.1	63.9	62.9	59.5	61.1	189.0	166.4	149.8	133.8	159.8	287.7	261.8	234.6	227.6	252.8
Winter	35.0	36.6	29.0	33.4	33.5	94.8	98.0	83.4	92.8	92.2	108.4	105.2	94.0	104.2	102.9
Summer	32.4	27.8	28.6	28.6	29.4	69.2	63.3	58.2	59.8	62.6	81.6	74.9	72.4	73.3	75.6
Mean	48.5	42.8	40.2	40.3		117.7	109.2	97.1	95.4		159.1	147.3	133.7	135.0	
LSD for season					1.0**					2.3**					3.5**
LSD for spacing					1.2**					2.7**					4.0**
LSD for Season × Spacing (interaction)					2.0*					4.6**					6.9

* Significant at 0.05, **: significant at 0.01 and no star means not significant

Table 3. Effect of sowing date and plant spacing on number of leaves per plant of Black mahlab:

Number of leaves per plant					
Season	Spacing (cm)				Mean
	10	20	30	40	
Autumn	573.0	144.4	2655.0	3026.0	1849.5
Winter	883.0	912.0	1374.0	716.0	971.3
Summer	1285.3	1174.5	1479.1	1215.9	1288.7
Mean	913.8	1076.8	1836.0	1652.6	
LSD for season					80.7**
LSD for spacing					93.2**
LSD for Season × Spacing (interaction)					161.4**

* Significant at 0.05, **: significant at 0.01 and no star means not significant

The different in number of leaves per plant among sowing dates were highly significant. Autumn sowing date resulted in the higher number followed by Summer and Winter. Sowing date had highly significant effect on number of leaves per plant. The highest number was obtained from the widest spacing and the lower number was obtained from the closer spacing. Interaction between sowing date and spacing was highly significant. (Table 3).

Data presented in Table 4 shows that the differences in the number of branches in the main stem per plant were statistically highly significant (p=0.01) among sowing dates. Autumn sowing date resulted in the highest number, followed by Winter and Summer. The differences in number of branches between the four spacing were also highly significant; the highest number was recorded from the widest spacing. Highly significant interaction was noted in this parameter (Table 4). Data presented in Table 5 shows that the differences in fresh weight per plant were statistically highly significant (p=0.01) among sowing dates. Autumn sowing produced the most vigorous plants followed by Winter and Summer. There were no significant differences in fresh weight per plant between the four spacing. Also the interaction between the sowing dates and spacing was not significantly differences (Table5).

Table 4. The effect of sowing date and plant spacing (S) on the number of branches per plant.

Number of Branches per Plant															
4 Weeks						4 Weeks					4 Weeks				
Seasons	Spacing				Means	Spacing				Means	Spacing				Means
	10	20	30	40		10	20	30	40		10	20	30	40	
Autumn	10	20	30	40		10	20	30	40		10	20	30	40	
Winter	14.8	17.2	19.4	18.2	17.4	25.0	28.9	35.0	34.8	30.9	30.8	32.6	35.4	36.0	33.7
Summer	9.4	10.4	9.8	10.6	10.1	11.8	12.4	12.4	12.2	12.2	11.4	13.9	12.8	12.6	12.7
Mean	11.0	12.2	12.5	12.7		16.7	17.6	19.7	19.6		18.7	19.6	19.9	20.1	
LSD for season					0.4**					0.4**					0.3**
LSD for spacing					0.4					0.5**					0.4
LSD for Season × Spacing (interaction)					0.7					0.8**					0.7**

* Significant at 0.05, **: significant at 0.01 and no star means not significant

Differences in dry weight per plant were significant (p=0.01) among sowing dates. Autumn sowing date accumulated the highest dry matter, while Winter the lowest. Higher significant differences were noted between the four spacing; with the widest spacing being superior. Highly significant interaction was noted between the factors. (Table 6).

Table 5. Effect of sowing date and plant spacing on fresh weight of Black mahlab:

Fresh Weight					
Season	Spacing (cm)				Mean
	10	20	30	40	
Autumn	536.0	558.0	614.4	799.2	609.4
Winter	386.6	399.7	442.0	452.4	420.2
Summer	117.1	127.6	195.1	164.4	151.1
Mean	346.6	361.8	352.5	448.7	
LSD for season					18.1**
LSD for spacing					22.1
LSD for Season × Spacing (interaction)					38.3

* Significant at 0.05, **: significant at 0.01 and no star means not significant

Table 6. Effect of sowing date and plant spacing on dry weight of Black mahlab:

Dry Weight					
Season	Spacing (cm)				Mean
	10	20	30	40	
Autumn	136.0	172.0	178.8	212.0	174.7
Winter	113.9	113.3	135.2	144.9	126.9
Summer	50.5	55.4	62.7	71.3	59.9
Mean	100.1	113.6	125.6	142.7	
LSD for season					6.2**
LSD for spacing					7.2**
LSD for Season × Spacing (interaction)					12.3

* Significant at 0.05, **: significant at 0.01 and no star means not significant

2.3. Effect of Sowing Date and Plant Spacing on Seed Yield

The differences in the number of fruits per plant were highly significant among sowing dates. The highest number was recorded from Autumn followed by Winter and Summer. Highly significant differences were noted in number of fruits per plant between the different four spacing. The widest spacing gave the highest number. Interactions were highly significant (Table 7).

Table 7. Effect of sowing date and plant spacing on number of fruits per plant of Black mahlab:

Number of Fruits per plant					
Season	Spacing (cm)				Mean
	10	20	30	40	
Autumn	548.0	1112.0	262.3	2995.0	1819.5
Winter	850.0	868.0	1323.0	657.0	924.5
Summer	1263.8	1446.9	1444.9	1166.0	1255.4
Mean	887.3	1042.3	1795.9	1606.0	
LSD for season					80.9**
LSD for spacing					93.5**
LSD for Season × Spacing (interaction)					161.9**

* Significant at 0.05, **: significant at 0.01 and no star means not significant

Table 8 shows that the differences in seed yield per plant were highly significant among sowing dates. The highest values were recorded from Autumn sowing date followed by Summer and Winter. Highly significant differences were noted in seed yield per plant between the different four spacing; the wider spacing gave the highest values. Interactions were highly significant (Table 8).

Table 8. Effect of sowing date and plant spacing on seed yield per plant Kg/Fed of Black mahlab:

Seed yield Kg/Fed					
Season	Spacing (cm)				Mean
	10	20	30	40	
Autumn	811.8	737.0	919.4	748.9	804.3
Winter	642.6	291.6	345.0	110.4	347.4
Summer	410.7	420.3	661.0	503.2	498.8
Mean	621.7	482.9	641.8	454.2	
LSD for season					35.8**
LSD for spacing					41.4**
LSD for Season × Spacing (interaction)					71.6**

* Significant at 0.05, **: significant at 0.01 and no star means not significant

Table 9 shows that the difference in weight of 1000 seed was highly significant among sowing; heavier seeds were produced from Autumn sowing followed by Summer and Winter. Spacing was significant (p=0.05), the widest spacing being superior. Interactions were highly significant (Table 9).

Higher oil content values resulted from the first sowing date (Autumn), while the lower values resulted in second and the last sowing dates (Winter and Summer). Oil content was not

affected by planting spacing (Table 10).

Table 9. Effect of sowing date and plant spacing on 1000 seed yield Kg/Fed of Black mahlab:

1000 Seed yield Kg/Fed					
Season	**Spacing (cm)**				**Mean**
	10	20	30	40	
Autumn	21.9	44.5	104.9	119.8	72.8
Winter	34.0	34.7	52.9	26.3	36.9
Summer	63.0	68.5	71.0	66.3	67.2
Mean	39.6	49.2	76.2	70.8	
LSD for season					3.2**
LSD for spacing					3.7*
LSD for Season × Spacing (interaction)					6.3**

* Significant at 0.05, **: significant at 0.01 and no star means not significant

Table 10. The effect of sowing date and plant spacing on the percentage of fixed oil of Black mahlab.

Fixed oil (%)			
Spacing	**Autumn**	**Winter**	**Summer**
10cm	18.73	9.76	9.6
20cm	18.79	7.75	9.31
30cm	16.16	9.86	9.60
40cm	17.75	9.94	9.02

3. Discussion

3.1. Effect of Sowing Date and Plant Spacing on Vegetative Growth

Autumn sowing was characterized by shorter time to 50% emergence than Winter and Summer sowing. This might be due to high temperature (28.4º to 36ºC), and high percent of relative humidity (29 to 43%), which prevailed during the germination period of Autumn sowing (appendix 1).the number of days to 50% flowering on the other hand was shorter in Winter and Summer than Autumn which could be attributed to relatively low temperature (20.3º to33.7ºC) and low relative humidity (19 to 29 %) during vegetative growth of Winter and Summer which might have resulted in earlier induction of flowering. This results confirm the finding of Mohammed A.(2000). Significant differences among different sowing dates were noted for plant height, number of branches per plant, number of leaves per plant, fresh weight per plant and dry weight per plant. Autumn sowing resulted in higher values for vegetative growth parameters than Winter and Summer. The significant effect of Autumn sowing might be attributed to the fact that plants had enough time to produce their maximum vegetative growth before the weather conditions were conducive to flower induction i.e. prevalence of relatively low temperature and low humidity. On the other hand, with Winter and Summer flower inducing environment prevailed before plants had reached their maximum vegetative capacity. Similar observations were reported by Lockley, (1980) and Wilhelis, (1979). Also Mohammed, (1992) found that both vegetative and reproductive growth parameters of both species of *Datura* gave higher values at 20cm and 30cm than 40cm and May sowing to be the optimum sowing dates. Vegetative growth parameters were significantly affected by plant spacing. Wider spacing gave higher values for all parameters; and was reflected positively on growth and yield components in contrast with closer spacing. This could be attributable to the fact that high plant population per unit area lead to competition for plant growth requirements such as sunlight, temperature, water ...etc. consequently resulted in poor plant development and crop establishment. Closer spacing of plant affected microclimatic conditions around plants and thus affected plant growth and morphology and as a result affected number of leaves per plant, number of branches per plant and fresh weight. These results are in the line with those reported on curl kale by Wilhelis, *et al.*,(1979) in Germany, and found that the tallest plant with the most green leaves per plant were obtained from the widest spaced plants.

3.2. Effect of Sowing Date and Plant Spacing on Seed Yield and Yield Components

Sowing date significantly affected seed yield, number of fruits per plant, and weight of 1000 seed. Autumn sowing produced the highest values for all parameters, while Winter and Summer gave the lowest values. The response of vegetative growth to sowing date discussed in (5.1) has been reflected positively on seed yield components with Autumn sowing and negatively with Winter and Summer.

These results are in the line with the findings of Mohammed, (2000), in the Sudan, and stated that the vegetative growth and seed yield and yield components of Black cumin were significantly affected by sowing dates. Early sowing dates gave higher values compared with late sowing. Similar observations were reported by Powell, *et al*.,(1993), studied the influence of the plant population on squash. They reported that the number and weight of fruits per plant increased linearly as increasing of plant spacing with in-row.

Data presented in table (4.10) indicated that seed oil content was significantly affected by sowing dates. Autumn sowing produced higher values compared to Winter and Summer. The significant effect of Autumn sowing date might be attributed to the fact that Autumn sowing resulted in higher vegetative growth and consequently well formed seed were produced containing higher amount of oil. On the other hand, Autumn sown plants efficiently used most of the growing season and reached their maximum development and ripening which mean more oil of the seed.

These results are in line with the findings of Penva (1984), who studied the effect of sowing date on yield of *chamomile*, found that flower essential oil and yield of Autumn sown

chamomile plants were about double that of Spring sowing date. Also Maheshwari and Trivedi (1989), studied the effect of planting date and planting methods on oil content and quality of Anise. They found that the highest yield of oil resulted from plants sown early (October). Ram, *et al*. (1998) in India, studied the effect of sowing dates and plant spacing on oil yield of Marygold *(Tagetes minuta)*. They reported that plants sown in mid-October at 45×45cm resulted in maximum oil yield with increase in plant height.

4. Conclusion

Results and conclusions drawn from this study can be summarized as follows:

1 In the Sudan Autumn reported to be the better sowing date.

2 Plant spacing positively affected vegetative growth and yield components and inversely related to seed yield. The wider plant spacing gave higher values for both vegetative and reproductive growth.

3 The fixed oil of Black mahlab seed was found to be higher in Autumn compared with Winter and Summer sowing date.

4 Further work is needed to determine the effect of sowing date on essential oil content of Black mahlab seed.

References

[1] Abdelmoneum MM. (2008). Cyto-toxicity and antimicrobial activities of *Monechma ciliatum* and *Kigelia africana*. Omdurman J. Phar. Sci. 1(4): 513- 522.

[2] Andrews, E. W (1952). *The Flowering Plants of the Anglo – Egyptian Sudan*. 2 Published by T. Buracle & Co LTD, Arboroach, Scotland.

[3] Ayoub SMH. (1981) Component fatty acids from the oils from *Monechma ciliatum*. Fitoterapia 2: 251

[4] El-Hassein, A. A. (1989). A study on The effect of Salinity and Sodicity on The Nutrient Status and Yield of Foster gape fruit (*Citrus Paradisi* macf). MSc. Thesis University of Khartoum, Sudan.

[5] Inga Hedberg and Frants Stangard (1989). *Traditional Medicine in Botswana*. Traditional Medicinal Plants. Ipelegeng Publisher Sweden.

[6] Lockely, G. C. (1980). Seed Science and Technology. (8). 3 Editors D. B. Mockany, F. Ader, A. G. Gorden and C. Hatin 23 – 244.

[7] Maheshwari, S. K; K. Trivedi (1989). Effect of Date and Method of Sowing on Grain and Oil Content and Oil Quality of Anise. *Indian Perfumer*. (33). 3; 169-173.

[8] Mariod AA, Aseel KM, Mustafa AA, and Ibrahim S (2009) Characterization of the Seed Oil and Meal from *Monechma ciliatum* and *Prunus mahaleb* Seeds. J Am Oil Chem. Soc. 86: 749

[9] Massey, R. E and Broun, A. F (1929). *Flora of the Sudan.*Thomas Murby and Co. London.

[10] Mohammed, A. A. (2000). Effect of Season, Plant Age, Cultural Factors on Herbage Yield and Alkaloid Content of Two (*Catharanthus roseus)* Cultivars. Ph.D. Thesis, Universityof Khartoum, Sudan.

[11] Mohammed, N. K. (1992). Response of *(Datura innoxia* L) and (*Daturastramonium* L) to Fertilizer Treatment, Plant Spacing and Sowing Date. M.Sc. Thesis University of Khartoum, Sudan.

[12] Oshi, M.A.M; Abdelkareem, A.M; and Eltohami, M.SH (2010) Extraction, antimicrobial Activities, and formulation of the Sudanese Medicinal Herb *(Monechma ciliatum)*. Thesis of M. Pham of Pharmaceutics, Omdurman Islamic University, Omdurman. 31

[13] Penva, P. T; Rasteniev Dni Nouki.(1984). Cultural Methodfor Medicinal Plants.*Horticultural Abstracts*.21(3): 39-44.

[14] Powel, C. A.; Peter, J. S. and Hangs, P. (1993). Plant Population Influence on Squash Yield, Sweet Potato white fly, squash sliver leaf and zucchini Yellow Mosaic. *Hort Science*. 28(8): 796 – 797.

[15] Ram, P.; Patra, N. K; Singh, H. H.(1998). Effect of Planting Date and Spacing on Oil Yield Components of (*Tagetes minuta*). *Journal of Medicinal and Adromatic PlantScience.* 20(3):742-745.

[16] Show, H. K. (1973). *A dictionary of The Flowering Plant and Ferns*. Eighth Edition. Cambridge.

[17] Uguru, M., Okwuasaba, A., Ekwenchi, E. C. and Uguru, V. E. (1998). Uterotonic Properties of The Methanol Extract of (*Monechma ciliatum)*. *Journal of Ethno pharmacology*. 62(3): 203 – 208.

[18] Uguru MO, Evan F. (2002). Phytochemical and pharmacological studies on *Monechma ciliatum*. J.Ethnopharmacol. 73: 289- 292.

[19] Wickens, G. E. (1976). The Flora of Jebel Mara (Sudan Republic)and ItsGeographical Affinities. London Her Majesty'sStationary Office.

[20] Wilhelis, E. (1979). Development of Plant Population with Curlykale (*Brassica oleraceae)* Grten Bcawiss en Schalt 44(2):74 – 83.