EFFECT OF SEASONAL VARIATION ON GROWTH, TOTAL HEBAGE, OIL AND CITRAL CONTENT IN LEMONGRASS (*CYMBOPOGON CITRATUS* STAPF).

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ABSTRACT

The influence of time of sowing and season on performance of lemongrass was studied by evaluating its growth rate, oil and citral content under semi arid condition at Shambat, Sudan. Statistically, planting dates and seasonal variation were significantly different regarding the trail evaluation. It appeared that the best month and seasons for planting were July and autumn (kharif), where the plant gave earlier emergence, higher growth rate and oil content. Citral content was not significantly affected.

ملخص

تمت دراسة تأثير مواعيد الزراعة والموسم على سلوك حشيشة الليمون وذلك بتقويم معدل النمو وكمية الزيت والسترال تحت ظروف شبه الجاف في شمبات بالسودان.

إحصائيا كانت تواريخ زراعة النبات والاختلاف الموسمي متباينة فيما يختص بتحليل وتقويم إنباته ونموه الخضري وكمية الزيت والسترال. فقد اتضح أن انسب مواعيد الزراعة هي شهر يوليو وانسب موسم هو الخريف إذ أن النباتات أعطت أسرع إنبات، وأعلى نمو خضري ونسبة زيت من موسمي الصيف والشتاء، فيما لم تتأثر نسبة السترال باختلاف مواعيد الزراعة والمواسم.

INTRODUCTION

Cymbopogon citratus (family *Poaceae*) is one of the most important and essential oil-producing grass grown in tropical and subtropical regions, due to its high citral content. The oil possesses a strong lemon odor hence the name lemongrass. The oil of lemongrass is widely used for scenting

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soaps, detergents and many kinds of technical products. The greatest amount of oil is employed for isolation of citral, which is used in flavors cosmetics and perfumes, or converted into ionones, a group of very important synthetic aromatics possessing a strong and lasting pungent odor.

Most of previous studies [7] were carried out to investigate impact of temperature as indicated by the effect of seasonal variation on plant growth, oil and citral content in open field cultivation. It has been found that under moderately high temperature, lemongrass gave vigorous growth, high oil and citral contents than in cool and rainy seasons [2,3,4,6,9]. Under dry seasons conditions, irrigation interval more than ten days are harmful to both growth rate and oil content. Moreover, leaves under water stress senesced more earlier resulting in very rapid fall in oil percentage [1].

In Sudan, lemongrass grows successfully all over the year for ornamental purposes. The objectives of this experiment were to identify the best sowing date and suitable time of year for the economic production of this valuable plant.

MATERIALS AND METHODS

The experiment was conducted in the Demonstration Farm of Faculty of Agriculture at Shambat–Sudan. (latitude 15° 40' N, longitude 32° 32' and Altitude 360m. above sea level). The climate of the locality is semi-arid with low relative humidity and daily mean maximum temperature of 40°C in summer and 21°C during winter, the corresponding minimum temperatures were 25°C and 15°C respectively. The annual rainfall was about 36 mm. The rainy seasons starts in July up to October with a peak in July (Figure1). The soil of the area is heavy texture montomorillonitic clay with 43% to 48% clay. Soil pH ranged between 8 to 8.3.

Cymbopogon citratus " lemongrass" (Family *Poaceae*) plants were raised from stools obtained from fully mature plants grown in the Botanical Garden at Elmogran Area, (Khartoum). The original plants were brought from the southern part of the Sudan where it grows wild. Botanical identity of the plants was confirmed by reference to the literature as which as the Department of Botany, Faculty of Science, University of Khartoum, authenticated the plants.

The land was well prepared, leveled, and divided into plots each $6x7m^2$, clumps of the grass were divided into uniform stools (rootstocks) and planted at the rate of three stools/hole [6], at a distances of 60 cm between plants in rows 75 cm apart. The design used was a complete randomized block design with four replicates. Considering the different seasons as the

three treatments, planting dates were distributed around the year as follows:-

First of November (winter)

First of April (summer)

First of July (autumn (kharif))

Each planting was left in the field for seven months for data collection. Watering, weeding and other agricultural practices were done when necessary.

In each growing season at least 5 plants from each plot were randomly selected for monthly measurement of the number of stools and weekly measurement for length of leaves as a criterion of growth. The week in which planting was made was considered to be week (zero).

After two and six months from the first leaf emergence 5 plants from each plot were randomly selected for growth analysis purposes and oil extraction. For oil extraction, leaves were always collected at 7 O'clock in the morning. Essential oil content was extracted from the fresh leaves, using Clevenger-type apparatus [5]. After distillation was completed, oil was permitted to stand undisturbed so that good separation was obtained. The volume of oil was measured and its percentage was determined. Citral content was determined by GLC (Pye, Unicam series 104) using 10% carbowax 3mx0.5 cm column. Temperature was programmed at 60 – 150°C at 1.5/ min with nitrogen flows rate of 1 ml/sec. The position of citral was confirmed by using an authentic sample from BBA (Bush, Boake Allen and Co. Ltd. Black horse lane, Walthamstowe, London E 17 England).

RESULTS

In the three different seasons, it was observed that the earliest emergence of the new leaves was in autumn (kharif) (Table 1). The highest slips (stools) multiplication (Figure 2), plant length (Figure 3), and herbage yield (Table 2), were obtained in autumn (kharif) compared to summer and winter seasons.

On the other hand, the higher oil content was obtained in autumn (kharif), while citral content was not affected at all by the variation of seasons (Table3).

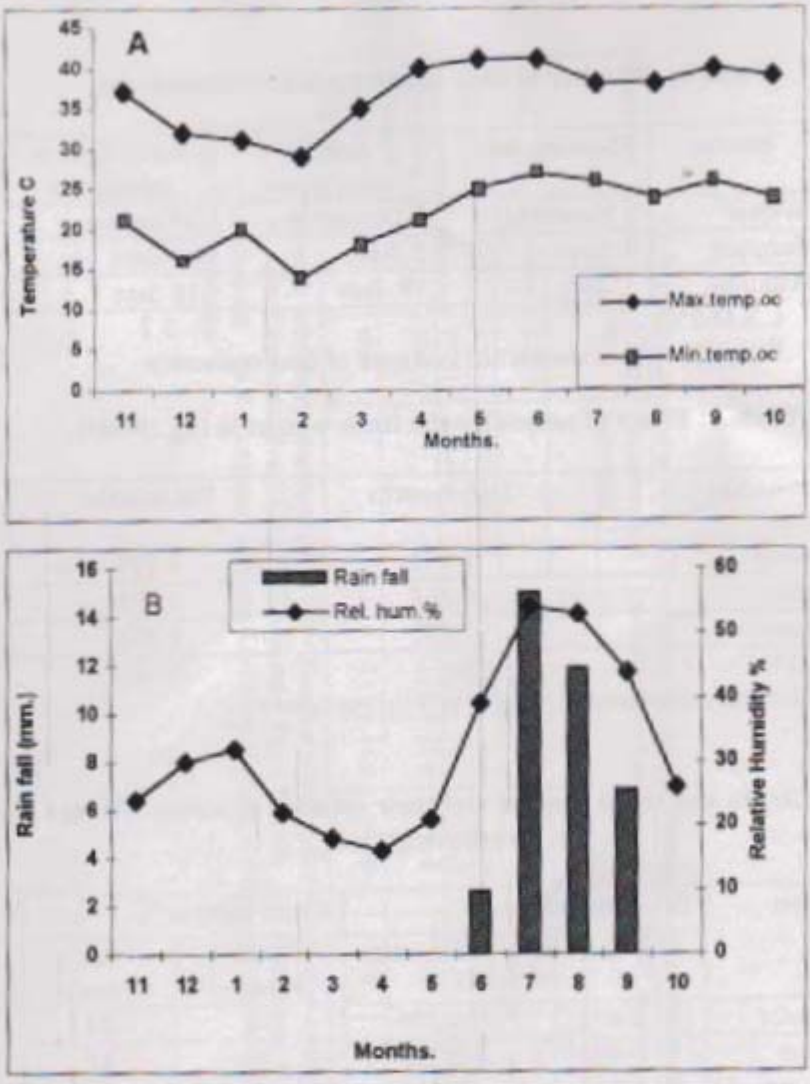

Figure 1: Maximum, minimum monthly temperature ^{o}C (A), and mean relative humidity and rainfall (B) during the experiment period at Shambat

Table 1: Number of days to emergence of lemongrass

Season	Sowing date	Date of emergence	No of days to emergence
Winter	1.November	5.December	34 days
Summer	1.April	2. May	31 days
Autumn	1. July	19. July	18 days
L.S.D.5%			3.2

Note : Numbers shown are averages of four replicates.

Table 2: Effect of season on the fresh weight in (kg./plant)

Age / Season	Two months	Six months
Summer	0.251	1.178
Winter	0.267	1.271
Autumn	0.457	1.492
L.S.D. 5%	0.01	0.06

Note: Numbers shown are averages of four replicates.

Table 3: Oil and citral content and their relation to season (% age of fresh weight)

Season	Oil content %		Citral content %	
	Two months	Six months	Two months	Six months
Summer	0.493	0.370	76	84
Winter	0.498	0.375	76	85
Autumn	0.613	0.415	77	85
L.S.D. 5%	0.06	0.01	N.S.	N.S.

Note: Numbers shown are averages of four replicates.
N.S.: not significant.

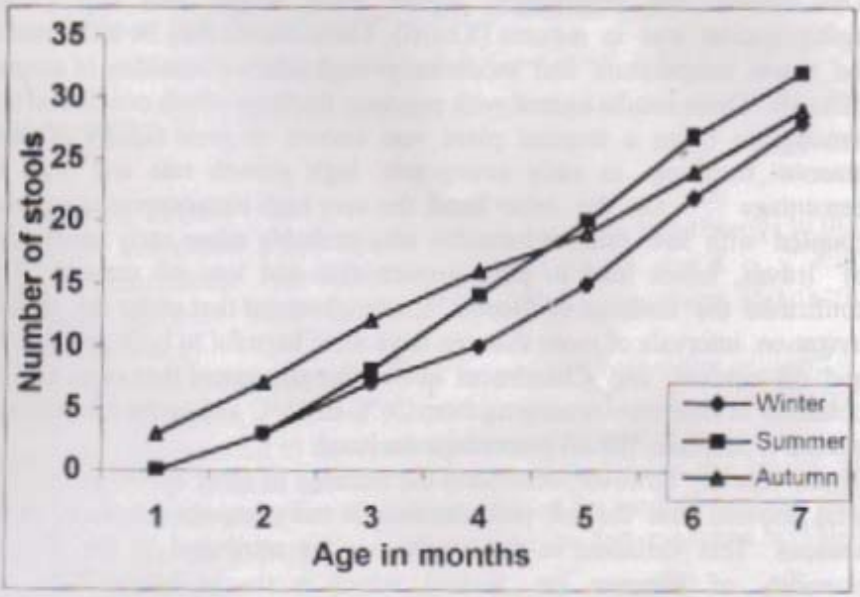

Figure 2: Effect of Seasonal variation on plant growth

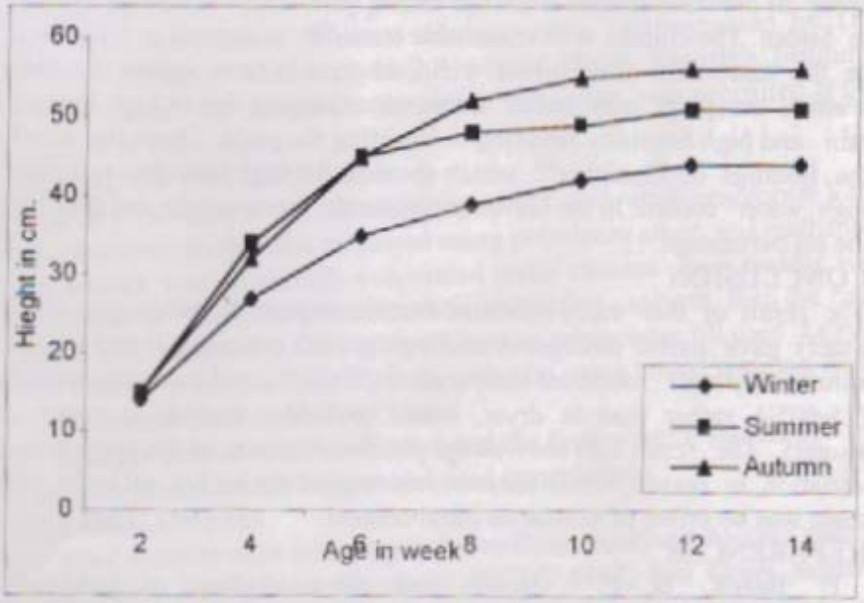

Figure 3: Effect of Seasonal variation on Leaf length

DISCUSSIONS

The earliest leaf emergence, higher plant length and slip (stool) multiplication was in autumn (Kharif). These results may be attributed to the warm temperature and moderately high relative humidity in autumn (Kharif). These results agreed with previous findings which concluded that lemongrass being a tropical plant was known to grow rapidly in warm seasons resulting in early emergence, high growth rate and high oil percentage [5,7]. On the other hand, the very high temperature in summer coupled with low relative humidity may probably cause early senescence of leaves, hence lead to poor growth rate and low oil content. This confirmed the findings of Beech [1], who observed that under dry season, irrigation intervals of more than ten days were harmful to both growth rate and oil content, and Chandra el al [2] who also stated that more oil was obtained at temperature ranging from 26°C to 35°C and as the temperature started to increase, the oil percentage declined.

These results, however, contradict the findings of other investigator [7,4,3,9] who showed that the oil yield declines in rainy seasons compared to dry seasons. This variation in the result may be attributed to the low air humidity of summer (in Sudan), which is always below 20%, and therefore it is harmful to the plant. The humidity in dry warm season in the areas of previous studies is always above 50%, which is similar to autumn in Sudan. The climate with reasonable humidity in autumn in Sudan might be the reason for the highest yield, whereas in rainy season in pervious studies, the plant may suffer from water logging due to high amount of rain and high humidity resulting in lowering the yield. These also confirm the findings of Guenther[6] which showed that high humidity resulting in high water content in the leaves increases the fresh weight and thus lower the oil percentage.

CONCLUSION

The result of this study indicated that lemongrass (*Cymbopogon citrates* Stapf) gave earlier emergence and high growth rate when it was grown in autumn (Kharif) moderate temperature (25-24°C) and moderate humidity (25-60%) rather than in dryer, hotter or colder seasons (summer and winter). The result also showed the positive response of the content to the variation in season, where autumn season gave the higher, oil yield, while there was no effect of season on citral content.

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