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INFLUENCES OF DIFFERENT SOWING DATES ON GROWTH AND YIELD OF LINUM USITATISSIMUM L. AT SHERINGAL, DIR UPPER, KHYBER PAKHTUNKHWA, PAKISTAN

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Abstract

The present experiment was conducted to examine the influence of the seeds sowing date on parameters like height of plant, number of the fruiting branches per flax plant, number of capsules, quantity of seeds per flax plant, weight (g) of (1000) seed of the Linseed (Linum usitatissimum L.) at the Sheringal, Dir Upper, Khyber Pakhtunkhwa, Pakistan. Experiment was designed in randomized complete block, consisting of three partitions. The sowing times of the plots were kept (1st February, 15th February and 1st March). The characters studied were the number of branches bearing fruit per plant, number of capsules per flax plant, seed number per capsule, plant height, and 1000 seeds weight. The data revealed that, sowing time has an important impact on height of the plant, numbers of capsules per plant and on the quantity of seeds in each pod. Mean comparison indicated that sum of the main fruiting branches of plant, number of capsule per plant, seeds number per pod in flax, plant height (cm), and 1000 flaxseeds weight were at the highest level observed in second sowing date (15th February). It was also noted that sowing date executed a positive change on all traits. The results showed that the yield of 1st February, 15th February and 1st March for number of seeds/capsule were 6.07, 6.20 and 5.18; likewise the parameter of 1000 seeds

weight 7.31 g, 8.26 g and 6.03 g. It was concluded that early sowing period had a positive effect on all the parameters studied.

Keywords: Linum usitatissimum L, Seeding date, Shaheed Benazir Bhutto University, Plant height

INTRODUCTION

The *Linum* L. genus to family Linaceae and consists of more than 200 species throughout the world (Daniel et al.).The Flax plant (*Linum usitatissimum* L), is recognized as cultivated common plant, Flax is diploid (2n=30) and is the only species of the family Linaceae, having agronomic significance (Allaby et al., 2005).The individual species in this family has agronomic as well as economic value. The generic *Linum*, name well-known to the Romans and Greeks, originates right from Celtic name *lin* means thread (Zajac et al., 2012), however, the latter word *usitatissimum,* in the name of species, specified by Carl Linnaeus, mean too beneficial, immediately mentions to the manifold presentations and its significance. Flax *Linum usitatissimum ssp. usitatissimum* distributed into numerous botanic groups of variety, amongst which particularly three varieties, convar. *mediterraneum, crepitans* and *usitatissimum,* are quiet of foremost significance in the farming (Zajac et al., 2012).

(Allaby et al., 2005) stated that Flax was originated around 10,000 years in the Middle East and extends to the Mediterranean Europe, Western and Central Asia and parts of Abyssinia. In North U.S.A Flax arrived nearly 400 years before, while in 1617 it was taken to the New France by Louis Hébert, the first grower in Canada (Burton, 2007). It remained under cultivation for getting flax fiber (straw fiber), or seed. The yield of Flax fiber is usually higher with a lesser amount of branches than linseed. In order, to improve the Flax fiber length in the straw resulted in the shortage of the yield of Flax seeds (Jhala & Hall, 2010).

Plant Taxonomy and Botanical Description

In the family linaceae Linum is the largest genus. Varieties of flax and cultivar of linseed are related species to *Linum usitatissimum*. Flax varieties are grown mainly for its fiber, while different types of flax are grown mainly for seeds. As a result, flax has the ability to have fewer flowers, to be taller and less seed than linseed. There are also varieties of dual-purpose of Linum, grown for both, fiber and seeds (Husain et al., 2009). Plant life cycle is

ranges from 90 to 150 days (Gabiana, 2005). Plant height ranges between 20 cm and 100 cm, depending upon by various cultivars (BEMILLER et al., 1993). Maturity of the seeds takes time of 30-60 days after flowering (Ivanov et al., 2012). The plant has branches out freely and has a specific well-defined main taproot and branches produce (Dipenbrock and Iwersen 1989). The plant stem consist of two components that is, bark of flax (outer Vascular cambium), the core (in internal areas Vascular cambium) and Flax stem bark include fiber lengths varying from 2 cm to 40 cm and a diameter of 20 cm to 23 cm (McDougall et al., 1993). Plant leaves of flax are gray-green in color, lanceolate, small and entirely glabrous. Flowers are self-pollinated and are produced on small branches. It produces a capsule of five cells, which contain the seeds of 5-10. Seeds are flat and oval in shape and they are yellow or brown in color (light brown to dark) at different stages of maturity and basically full of protein and oil (Diepenbrock & Iwersen, 1989).

Flax is highly self-pollinating species of diploid nature (2n = 30), with complete, accurate and pedicel late flower (Jhala et al., 2011). Parts of the Linseed flowers: sepals, stamens, nectaries and gynoecium, and petal (Schewe et al., 2011). Ovary have the five carpels all of which has the capability of developing two seeds, each capsule contains maximum of 10 seeds. The color of the petals can varies from the dark color to light blue color, or it might be white or pink light. The flowers open in the field, shortly after sunrise, where in the afternoon the fall of the petals. A number of make this possible through cross-pollination insects occur at very low levels. Flower open in the field shortly after dawn, where the petal is drop before evening (Freer, 1991). Cross-pollination is occurring, by insect at very low level some time. Flax seed are usually flat, shiny, slimy and oval in shape, at the end of the axis of the embryo. Color of seeds vary between varieties, and can vary from light brown color to dark brown color or yellow color. In general, in the Western Canada the normal lifecycle period of flax plant is 100 days. Where 1st half of the lifecycle as known as vegetative phase and the second half consists of flowering and the stage of maturity. Fibers that are initiated in the cortical area of the flax stems between external skin and heart tissue Woody inside are composed of long cells that lack septa that come from procambium (undifferentiated) cells in proto-phloem (Burton, 2007; Morvan et al., 2003). Flax fiber cells have very thicker and longer secondary walls (Morvan et al., 2003).

Flax plant cells are organized in the amount of packets from one up to three dozens of the cells, which surround the vascular cylinder in the Flax. Two basic stages are there in the growth of fiber that is cell elongation and thrombosis of secondary walls. Elongation of

fiber cells occurs in the upper part of the stem and length of fibers are related to the internode. During the maturation of secondary walls, a deposit happens afterward the flowering and fills the fiber for the period of the development of the pod. Fiber obtained from the Flax has high tensile strength and low elasticity thus provides safety in opposition to the insects as well as mechanical strength to the stem (Roach et al., 2011).

After the cotton crop as a fiber crop the Flax (*Linum usitatissimum* L.) is categorized second fiber crop, concerning the cultured areas or its significance in manufacturing. Flax crop is one of, the prehistoric significant plant grownup for oil and fiber nearby utilized in fabric manufacturing. Linseed in Pakistan it is cultivated on an area of 4,700 hectares with yields of 2,710 tons per annum with an average yearly production of 573 kg/ha (Khan et al., 2005). Oil from Linseed is one of the ancient economically important oils used in painting, varnish, and food manufacturing. Linseed Flax is well thought out one of the best significant double persistence harvests for fiber and oil manufacturing in the world, Flax Linseed is sufficient in dietary fiber (20 to 28%), protein (20 to 25 %), fats (30 to 40%), (4 to 8 %) moisture and (3 to 4 %) ash (Pradhan et al., 2010). Fiber Flax is one of the ancient harvests grown for its fibers and seeds since Pharaoh Age. Linum is an economically significant harvest which takes an important part in our plans, by means of its native fabric manufacturing value. Nowadays, though there is a better attention in linseed crops, specifically flax, for the reasons of their fuel use e.g. biofuels, as alternates for human utilization and for petroleum products. At the modern era a lot of determinations were made to improve the production of the flax, through enlightening the better cultivating processes such as seeding rates and planting date for betterment of the production and quality of the flax. Numerous struggles have completed, to get the best out of total creation of linseed oil crops to bond the gap amongst native utilization and production from eatable vegetable oil by increasing farming of flax crop. Due to the great struggle the cultured area in the 20 last years was reduced from 25000 to 12500 hectare, of resulting in other economically important winter crops in a gap among consumption and production. As a result, it is essential to improve flax efficiency per unit area that might be attained by improving the agricultural treatments and using high yielding cultivars (Hussein, 2007; Ibrahim, 2009).

Objectives

Keeping the significance of cultivar, on the basis of seeding rate and planting date to examine the influence on quality and its harvest traits of flax and select the planting rate and best sowing date. Moreover, to evaluate progress statistical models should be used to designate the interactions amongst, seeding date and growth, yield component and yield.

METHODS

Experimental site and Agro-Meteorological Conditions

This field study was carried out at the experimental farm of Shaheed Benazir Bhutto University Sheringal, Dir Upper, Khyber Pakhtunkhwa, Pakistan, located along the bank of River Panjkora, in Hindukush Himalayan region at 35°16′27.38″ North latitude and 72°00′10.54″ East longitudes in Pakistan and 1417.07 meter (4648 feet) above the sea level. Dir Upper district is linked by Lawari Tunnel to the Central Asian countries, across Chitral via Wakhan strip (Afghanistan) and is surrounded by thick, lush and green temperate forest cover.

Average annual air temperature at the site is 11.5°C and average annual precipitation at the location is 2077 mm. During August, the temperature is in the range of 32-25 °C with intermittent rains and a soothing weather. The soil properties at the experimental site and meteorological data are listed in the tables 1 and table 2 respectively.

Field Experimental Design

The study was fulfilled in a randomized complete block with three plots, size of each plot was 3×5 m^2 with 6 rows; each row was 50 cm apart and in each row the distance between plant to plant was kept as 10 cm. The treatments sowing dates (1st February, 15th February and 1st March) were fixed. Seeds were obtained from the Pakistan Forest Institute Peshawar, Khyber Pakhtunkhwa, Pakistan. The normal cultural practices of growing flax were kept for three months under natural conditions, till gaining full maturity after that harvesting was carried out. The experimental timing was conducted, when plants were at four leaves stage after emergence. The data were recorded on plant height (cm), number of main fruiting branches, and number of seeds per capsule, number capsules per plant and 1000 seeds weight (g).

Measurements

At full maturity time, twenty plants of flax were taken randomly from each of the plot to assess plant height in centimeter (cm), number of fruiting branches, number of capsules per plant, number of seeds per plant, 1000-seed weight in gram (g). Harvested plants were tied and left to dry, there after they were threshed to isolate the capsules and weighed. Seeds were cleaned from straw and other residues and weighed using a digital balance.

Table 1 Chemical and physical properties of the soil at experimental site, at 0 to 30 cm depth tested at Sugar Crops Research Institute, Mardan

Chemical characters	Organic matter	0.80 %	**Physical characters**	Clay	33.00 %
	Nitrogen	0.39 %		Silt	30.00 %
	Phosphorus	4.37 mg / kg		Sand	52.00 %
	Potassium	75.00 mg / kg		Soil Texture	Sandy loom
	pH	7.45			

Table 2 Meteorological data of Sheringal, Dir Upper for the study period were taken from https://tcktcktck.org/pakistan/khyber-pakhtunkhwa/sheringal

	January	February	March	April	May	June	July	August	September	October	November	December	Year
Average low °C (°F)	0.55 (32.99)	2.49 (36.48)	7.1 (44.78)	12.28 (54.1)	17.44 (63.39)	21.71 (71.08)	23.21 (73.78)	20.08 (68.14)	15.96 (60.73)	11.37 (52.47)	5.49 (41.88)	2.08 (35.74)	11.65 (52.97)
Average high °C (°F)	12.12 (53.82)	13.31 (55.96)	18.56 (65.41)	25.0 (77.0)	31.54 (88.77)	34.77 (94.59)	33.27 (91.89)	30.26 (86.47)	27.89 (82.2)	23.83 (74.89)	18.05 (64.49)	14.59 (58.26)	23.59 (74.46)
Daily mean °C (°F)	7.63 (45.73)	9.34 (48.81)	14.7 (58.46)	21.36 (70.45)	27.83 (82.09)	31.55 (88.79)	30.43 (86.77)	27.43 (81.37)	24.99 (76.98)	20.39 (68.7)	13.46 (56.23)	9.38 (48.88)	19.87 (67.77)
Average relative humidity (%)	42.26	54.8	53.47	49.23	37.52	35.97	57.91	70.76	58.27	40.71	37.0	31.87	47.48
Average precipitation mm (inches)	77.03 (3.03)	225.54 (8.88)	193.61 (7.62)	163.37 (6.43)	88.23 (3.47)	72.73 (2.86)	271.9 (10.7)	277.5 (10.93)	93.49 (3.68)	49.66 (1.96)	56.99 (2.24)	30.83 (1.21)	133.41 (5.25)
Average precipitation days (≥ 1.0 mm)	7.22	11.6	13.94	17.64	11.6	9.94	22.43	23.4	15.02	6.15	4.88	3.6	12.29

RESULTS AND DISCUSSION

Plant height

So far as the parameter like plant height is concerned, prominent changes were found in various sowing dates. The second sowing date (15th February had the highest plant height with 113.05 cm was noted in second sowing date (15th February) while 105.38 cm and 98.22 cm were noted in first and second sowing dates respectively after first and third sowing dates had 105.38 cm and 98.22 cm respectively (Table 3). Thus, the influence of sowing date had a significant impact on plant height of flax. (Ghanbari-Odivi et al., 2013) and (Esendal et al., 2008) also reported in case of safflower that the main reason of this outcome may be attributed by dropping of vegetative growth period. The cause of decline in plant height might be because of changing of plant vegetative phase into flowering phase due to high temperature at vegetative stage and as a result the vegetative phase is checked.

Number of branches per plant

Meaningful variation were observed and noted among various sowing dates in case of number of main brunch. The maximum number of branches per plant were noted in second sowing date (15th February) 9.99. While it is reduced in other sowing dates. However in first and third sowing dates the number branches per plant were recorded 8 and 8.25 respectively (Table 3). Moreover, the maximum numbers of main branches per plant were noted in second sowing date (15th February), while minimum of number of main branches per flax plant were observed at 1st February.

Numbers of pod/capsules per plant

A considerable impact on numbers of pod/capsules in each plant in fiber flax was observed with reference to sowing date. The highest numbers of capsules per plant were recorded as 25.25 in second sowing date (15th February), showing somewhat decreasing value, although in first, third and fourth sowing dates recorded as 23.00 and 20.15 respectively. Significant variation was shown among sowing dates in the parameter of number of capsule per plant. Furthermore the highest number of capsules per plant was recorded in second sowing date (15th February) while lowest number of capsules per plant was found in third sowing date (Table 3). It was concluded that sowing date significantly affected the number of capsules in each plant in Flax.

Table 3 Flax seed plant height (cm), number of fruiting branches, capsules in each plant and number of flaxseeds per plant, 1000 seeds weight (g) at different sowing dates

	1st February	15th February	1st March
Plant height (cm)	105.38 cm	113.05 cm	98.22 cm
Number of fruiting branches	08.00	09.99	08.25
Number of capsules per plant	23.00	25.25	20.15
Number of seeds per plant	06.07	06.20	05.18
1000-seed weight (g)	07.31 g	08.26 g	06.03 g

Flaxseeds per capsule

Maximum flaxseeds per capsule with value of 6.20 were recorded in second sowing date (15th February) while 6.07 and 5.18 seeds in capsules were noted in 1st February and 1st March respectively. Sowing dates showed significant differences in case of parameter like, number of seed per capsule (Table 3). Second sowing date (15th February) with maximum seeds as 6.20 was recorded as maximum seeds in capsule. First and third sowing dates reported with the value of 6.07 and 5.18 seed in capsule correspondingly. In this way it was concluded that number of fruits per plant per unit area is the prominent output of this study. The maximum seeds per capsule or fruit production is because of effective assimilation of Photosynthesis in the prevailing situation of environmental factors observed. Other varieties or species of Flax may be examined under the same dates of sowing to screen out the species/variety for better yield.

1000-seed weight

Study of differences pointed out that sowing date was affecting significantly the parameter like 1000 seed weight (Table 3). It was studied that the highest and the lowest seed weight 8.26 and 6.03 (g) were produced under second and third sowing dates respectively. In this study, the highest seed weight was recorded in second sowing date (15th February) 8.26 (g) in comparison to the 1st and 3rd sowing date (at 1st February and 1st March).

CONCLUSION

The points, which are concluded, may highlight as; there is a great variation in the yield component of linseed under different metrological conditions found. Suggested sowing dates for the species/varieties ecotypes of crop under study vary depending on environmental fluctuations. Linseed yields and its yield components varied significantly in three trials in response to different meteorological conditions. Flax cultivars are suggested to be planted at (15th February) keeping row to row distance as 30 cm and the distance between plants will be kept as 3 cm 4 cm for attaining maximum seed yield under metrological conditions of Sheringal, Khyber Pakhtunkhwa, Pakistan. The economically important plant sowing dates were practiced in this study presented fruitful results as a result of the findings of this research. Briefly, the results of the present study may be useful for the approval of optimal sowing date stress to get reasonable yield under prevailing meteorological conditions.

(a) (b)

Figure (a,b) *Linum usitatissimum* L.) Flower and Capsule

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