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EFFECT OF PLANTING DEPTHS ON SOME AGRONOMIC CHARACTERISTICS OF *ALLIUM TUNCELIANUM*

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Abstract

Allium tuncelianum [(Kollman) N. Ozhatay, B. Mathew & Siraneci] (Syn: A. macrochaetum Boiss. and Hausskn. subsp. tuncelianum Kollman) is an endemic plant species and has been proposed as the wild ancestor of garlic. This study reports agronomic and morphological feature of a field experiment conducted during October 2013 to July 2014 under arid conditions of Turkish province of Diyarbakır to investigate the effect of 7.5 and 15 cm planting depth on morphological features of the plant. The experimental results indicated significantly positive effects of shallow sowing (7.5 cm depth) on vegetative characteristics like plant height, stem diameter, leaf length, bulb circumference, bulb diameter, number of bulbils per plant and bulb weight compared to deep sown (15 cm) bulbs. Flower diameter values varied between 5.74 and 6.07 cm, bulb diameter 2.79 and 3.06 cm and bulb weight between 21.01 and 23.67 g, respectively. Deep sowing had positive effects on generative characteristics like leaf width, number of leaves per bulb, length of leafless stems and inflorescence diameter.

Key words: *Tunceli garlic, agronomy, bulb growing, yield.*

INTRODUCTION

Allium tuncelianum [Allium tuncelianum (Kollman) N. Ozhatay, B. Mathew & Siraneci](Syn: *A. macrochaetum* Boiss. and Hausskn. subsp. *tuncelianum* Kollman) is native to “Tunceli” province in Turkey and grows in limited area especially close to Ovacik and Pulumur districts. Like all other forms of garlic, Tunceli garlic is odourless until the plant cells are damaged through biotic or abiotic means. Physical injury to bulbs generate strong-smelling and biologically-active organic sulphur compound, allicin (thio-2-propene-1-sulphinic acid S-allyl ester). Allicin has been reported to have anti-coagulant, anti-hypertensive, anti-microbial, anti-biotic, anti-parasitic, anti-mycotic, anti-viral, anti-tumor, anti-oxidant, and anti-aging activities (Jacob, 2006; Ozkan et al., 2013; Kizil et al., 2014). Allicin is also known to detoxify heavy metals, be hypo-lipidaemic (i.e., lipid-lowering), anti-carcinogenic, and anti-mutagenic (Munchberg et al., 2007; Iciek et al., 2009; Ozkan et al., 2013). These smelly compounds also serve to defend plants against predators, parasites and diseases (Block, 2010). Development of garlic for the nutraceutical industry has resulted in growth of another specialty market with high levels of sulfur compounds such as allicin that are often correlated with strong flavour.

Unlike commonly used garlic, Tunceli garlic is a single clove plant that can be easily propagated using seeds and bulbs. The plant can be stored for a long time at 18-20°C. Bulb plants are a hardy perennial that prefer full sun and fertile, well drained soils with plenty of organic matter. Suitable planting depth influences available space for development of plant and, therefore, bulbs and seeds should be planted accordingly.. Additionally, the planting depth influences time to emergence and subsequently flowering time and total

crop duration. Hence, planting at a uniform depth is necessary for a uniform crop time (Padhye and Cameron, 2007).
This study aimed to find effects of planting depth of Tunceli garlic outside its natural habitat under arid conditions of South-eastern Anatolia by planting bulbs at two depths.

MATERIALS AND METHODS

Field studies were conducted under semi-arid Diyarbakır South East Anatolian ecological conditions (latitude 37^o 53' N and longitude 40^o 16' E, 680 m above sea level), Dicle University during October 2013 to July 14 growing season using bulbs of *Allium tuncelianum* L. obtained from local producers at Ovacik in Tunceli province of Turkey.
Soil conditions of the experimental site, taken at depth of 0 to 40 cm, showed that it had 1.16%, organic matter, 0.16% total salts, 66.0% saturation percentage (%) with water, no lime ($CaCO_3$), 61 kg ha^{-1} phosphorus (P_2O_5), no potassium (K_2O) with soil pH of 7.45 and Electrical conductivity (mmhoscm^{-1}) of 3.8.
Climatic conditions in the experimental year, with mean temperature, relative humidity and total precipitation from September to July 2013-14 was 20.1 ^{o}C, 56.7%, and 44.7 mm. Long term with September to July, mean temperature, relative humidity % and precipitation were 12.8 ^{o}C, 59.1% and 48.74 mm, respectively.
Experimental fields were watered before planting. Planting was done with row spacing of 70 cm and plant spacing of 20 cm in the month of October.
The experimental design was a randomized complete block design with three replications with two planting depths. The experiment was planted on September 1 with 48 bulbs in each plot. Plots size was kept 6.3 m^2 (2.1 × 3 m) in each experiment. Planted bulbs had diameter of 17 to 19 mm and were hand planted at a depth of 7.5 ±1 cm and 15±1 cm in the soil.
The plots were weeded as and when required.
The plots were harvested manually on 5th July, 2014.
Plant height, plant stem diameter, leaf length, leaf width, number of leaves per plant, length of leafless stem, number of bulbils per plot, bulb circumference and bulb weight using IBM SPSS 20 for windows statistical software. The means were grouped, using "t" test at 0.01 level of significance.

RESULTS AND DISCUSSIONS

The results of the study showed significant effects of sowing depths on different morphological features of Tunceli garlic (Table 1& 2).

Table 1. Some agronomical traits obtained from different planting depths of Tunceli garlic

Deep (cm)	Plant height (cm)	Stem diameter (cm)	Leaf length (cm)	Leaf width (cm)	Number of leaf	Length of leafless stem
7.5±1	115.7a	1.20a	39.7a	1.41b	6.8b	85.8b
15±1	114.7b	1.18b	38.3b	1.74a	7.1a	88.0a
Mean	115.2	1.19	38.9	1.57	6.9	86.9

*Each value is a mean of 45 bulbs and values given in a single column are significantly different using t test.

The maximum plant height, stem diameter and leaf length values were obtained in shallow planting. The study revealed that leaf width and number of leaf per plant values were significantly high in the deep planting.
Greater sprouting was recorded when plants were planted with both 7.5 and 15 cm depths. The results showed that Tunceli bulbs gained positive gains in terms of vegetative growth at 7.5 ±1 cm depth.
Bulb sowing increased plant height (115.7 cm) at 7.5 ±1 cm deep sowing. Growing plant showed more increase in plant stem diameter (1.20 cm) with significantly longer leaves (39.7 cm); bulb circumference (12.81 cm), bulb diameter (3.06 cm) and bulb weight (23.67 g) (Table 1 & 2, Figure 1).
There is no information about stem diameter and length, leaf length & width of Tunceli garlic under natural conditions. It gains bulb diameter of 6-7 cm with bulb weight of weight (10-30 g) depending on culture conditions (OGM, 2014).

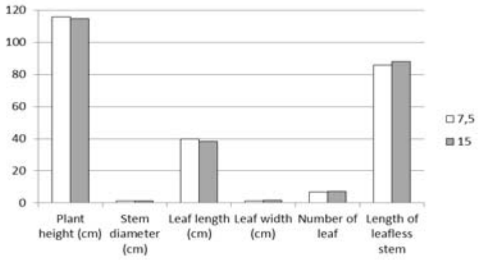

Figure 1. Variation of some agronomical traits obtained from 7.5 and 15 cm planting depths of Tunceli garlic

It is reported that plants were taller when bulbs were planted deep because of better soil temperature for growth and soil holding around the bulbs which helped in maximum nutrients uptake from the soil (Amjad and Ahmad, 2012). These results are not compatible with the results of this study in terms of plant height and leaf length.

Larger bulb containing higher food reserves produced higher number of flowers and had positive impact on other characteristics. Finally, it was observed that the deeper planting produced the highest flower diameter (6.07 cm) while the lowest bulb weight also was noted from 7.5 cm planting depth. However, characteristics like leaf width, number of leaves per bulb, length of inflorescence stem, inflorescence width and number of scales that have direct bearing on generative growth were significantly affected at deeper (15 ±1 cm) sowing (Table 1 & 2, Figure 2). The results showed deeper sowing with more leaf width (1.74 cm), number of leaves per bulb (7.1 cm), longer inflorescence stem (88.0 cm), inflorescence width (6.07 cm), inflorescence length (65.18 cm) and number of scales per bulb (2.23). This information is in line with the OMG (2014).

Table 2. Some agronomical traits obtained from different planting deep of Tunceli garlic

Deep (cm)	Flower diameter (cm)	Bulb circumference (cm)	Bulb diameter (cm)	Number of bulbils	Number of scales	Bulb weight (g)
7.5±1	5.74b	12.81a	3.06a	0.86a	2.16b	23.67a
15±1	6.07a	12.25b	2.79b	0.8.0b	2.23a	21.01b
Mean	5.90	12.53	2.92	0.83	2.19	22.34

*Each value is a mean of 45 bulbs and values given in a single column are significantly different using t test.

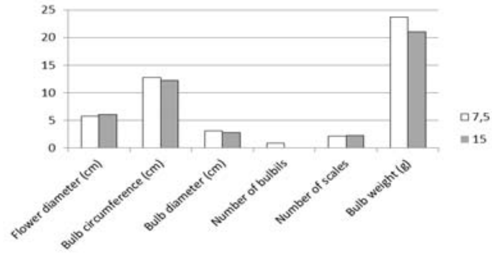

Figure 2. Variation of some agronomical traits obtained from 7.5 and 15 cm planting depths of Tunceli garlic

There is no report about the effects of sowing depth on Tunceli garlic. Tunceli farmers generally sow Tunceli garlic at depth of 2- 3 cm without considering effects of sowing on physiological parameters. It is normally sown during October and harvested during August (approximately 300 days). Temperature of the area remains 18 - 20 °C during growth period. This is first experiment that has been performed outside natural habitat of Tunceli Garlic. The results of experiment clearly indicate that this bulb could be successfully grown out of its natural habitat without adverse effects on growth. Performance of Tunceli garlic propagated by vegetative reproduction is influenced by the sowing depth. Variable response of different parameters in differential vegetative and generative growth may be attributed to the bulbs planting at differential depths. Deeper sown bulbs needed more time to come out of soil after sprouting and were adversely affected towards vegetative growth. However, they induced earlier flowering. Furthermore, the bulbs sown at shallow depth had more chance to remobilise reserved metabolites, mainly carbohydrates for their own growth and development due to early start of photosynthesis. The deeper sown bulbs went to generative growth earlier compared to shallow sown bulblets. The results are in agreement with Rabinowich and Brewster (1990) and Pooler and Simon (1994).

CONCLUSIONS

Shallow sown bulbs produce large bulbs at harvest and have better bulbil formation as compared to deep sown bulbs. Therefore, growers must prefer shallow sowing for increased bulb yield. However, deep sowing could be preferred for seed harvest.

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