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The Effect of Vermicompost Doses to Different Leek (*Allium ampeloprasum* var. *porrum* L) Varietés on Growth and Shaft Yield in Southern Ethiopia

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Abstract

Leeks (*Allium ampeloprasum* var. *porrum* L) originate in the Mediterranean basin. It is one of the Allium vegetable crops growing in Ethiopia particularly leeks of the country. Variety and location specific optimum vermicompost/organic fertilizer rate recommendation is one of the agronomic principles used to increase intensive farmer and food security of leek. However, there is a blanket recommendation across locations and varieties of leek in Ethiopia. Hence, field experiment was carried out to determine the effect of inter- and intra- row spacing on the phenological, growth, yield and yield related traits of three leek varieties during 2023 cropping season at Dalbo Wogene Kebele, Zuria Woreda, in Wolaita Zone, Southern Ethiopia, Central Ethiopia. Factorial combinations of three leek varieties (Carentan Giant, 'Titan' and. 'Dawn Giant'), three vermicompost (2.5, 3.75 and 5 t/h were laid out in a randomized complete block design with three replications. Days to 90 % physiological maturity, leaf length, leaf width and Leave Number per plant were significantly affected by the main effect of variety, vermicompost. Moreover, the main effect of variety showed a significant effect on the plant height and Dry matter weight, biological yield and total shaft yield were also affected significantly by the main effects of inter- and intra-row spacing. Varieties Titan' (8.44) days and 'Dawn Giant' (9.06 days) germinated earlier than variety Carentan Giant (9.94) days. However, variety 'Titan' took the maximum number of leaves (46.33), days to 90 % physiological maturity (111.67) and pods per plant whereas variety Carentan Giant gave the highest plant height (41.24 t/h) and hundred seed weight (63.54 g). As the inter- and intra-row spacing increases the days to 90 % physiological maturity and leaf number per plant increases whereas biological and shaft yield decreases. From this, it could be concluded that leek varieties (Carentan Giant, 'Titan' and 'Dawn Giant') could be applied at optimum levels of vermicompost 3.75t/h with Carentan variety in Dalbo Wogene area to attain maximum yield though it is done in one year and variety characterization.

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Introduction

Leek (*Allium ampeloprasum* var. *porrum* L.) belongs to the genus *Allium* of the family *Alliaceae* (Hanelt, 1990). It is closely related to the onions. It is a biennial plant and its reproductive system is predominantly cross-fertilization although self-fertilization is possible (Meer and Hanely, 1990). Leek is a slow growing monocotyledonous species of the genus; it is characterized by broad, flat, tightly wrapped, dark green leaves, a long, thick white stalk, and a slightly (to some extent) bulbous end. It is very tolerant to cold weather, although the optimum temperature for vegetative growth is around 20 °C. The leaves and long white blanched

stem are eaten cooked or can be added to salads (Theunissen and Schelling, 1998).

Vermicompost is the product derived from the accelerated biological degradation of organic wastes by earthworms and microorganisms is called vermicompost. It is finely divided peat-like materials with high porosity, aeration, drainage and water holding capacity. Compost as the organic waste can be a valuable and inexpensive fertilizer and source of plant nutrients. Positive effects of organic waste on soil structure, aggregate stability and water-holding capacity were reported in several studies, (Jedidi, 2004; Odlare, 2008; Shen and Shen, 2001; Wells, 2000).

A number of problems associated with biotic and abiotic stresses as well as improper agronomic practices account for the low yield of leek in Ethiopia. Specifically, major production constraints include lack of proper planting material (of improved varieties), inappropriate agronomic practices, absence of proper pest and disease management practices (leek rust, downy mildew, basal rot, white rot, purple blotch and onion thrips), absence of marketing facilities, and low soil fertility status in many soil types (Getachew and Asfaw, 2000). Lack of quality seed suitable for different agro-ecological zones, low soil fertility, and lack of appropriate fertilizer recommendations have often led to low yield and quality of leek in Ethiopia. Particularly for *Allium* crops, adequate sulphur (S) supply is needed for the development of pungent flavours and for healthy growth of the plants (Randle, 1997). A study by Lancaster *et al.,* (2001) showed that onions grown with very low sulphur produced softer bulbs than those grown with adequate supplies of the nutrient.

Most smallholder farmers in Ethiopia, particularly at Dalbo, Sodo Zuria, District, appreciate the value of fertilizers, but they are seldom able to apply them at the recommended rates and at the appropriate time because of high cost, lack of credit, delivery delays, and low and variable returns. Organic inputs are often proposed as alternatives to mineral fertilizers. However, the traditional organic inputs such as crop residues, and animal manures cannot meet crop nutrient demand over large areas because of the limited quantities available, the low nutrient content of the materials, and the high labor demands for processing and application (Palm *et al.,* 1997). On the other hand, the application of bio-fertilizers such as vermicomposts have been recognized as an effective means for improving soil aggregation, structure and fertility, increasing microbial diversity and populations, improving the moisture-holding capacity of soils, increasing the soil Cation Exchange Capacity (CEC) and increasing crop yields (Hargreaves *et al.,* 2008). They also reported that municipal solid waste compost can also reduce the volume of the waste, kills' pathogens that may be present, decreases germination of weeds in agricultural fields, and destroys malodorous compounds. Earthworms have an important influence on soil structure, forming aggregates and improving the physical conditions for plant growth and nutrient uptake (Ansari and Sukhraj, 2010). During vermicomposting, earthworms eat, grind, and digest organic wastes with the help of aerobic and some anaerobic micro-flora, converting them into a much finer, humified, and microbial active material. In addition, Brewster (1994) reported that leek bulb yield increased asymptotically as plant density increases and that mean bulb size correspondingly declined.

Considering the importance of leek as one of the potential vegetable crops for both domestic consumption and export, it is very important to increase its productivity along with appropriate management practices. Therefore, there is no location and variety specific recommendation on the plant spacing of leek cultivars in Ethiopia. In view of the above facts, the present study was undertaken. Therefore, the objective of this study was; to evaluate the effects of vermicompost on growth and yield of leek varieties in study area.

Materials and Methods

Description of the Study Area

This experiment was conducted during 2022 to 2023 cropping season at Farawoch at fruit and vegetable nursery site of Dalbo Wogene Kebele, Zuria Woreda, in Wolaita Zone, Southern Ethiopia. An approximate geographical coordinates of the site is located at 7°08′15.1"N N latitude and 37^{o} 41''.330' E longitude having an altitude of 1730 meter above sea level. The experimental area is characterized with bimodal rainfall distribution pattern which extends from March to September receiving mean annual rainfall of 1459.1 mm with a bimodal pattern, which extends from March to September. The peak rainy months are April, July, August and September. The mean annual minimum and maximum temperature of the site was 15 and 26 ^{o}C, respectively. Soil types of the study area are sandy loam (BBWARDO, 2011). November and December were the coldest months, whereas February was the hottest. (Dawit, 2014)

Description of Experimental Materials

The leek varieties used in the study were: Carentan Giant (CG), 'Titan' and. 'Dawn Giant' Two varieties were Carentan Giant and 'Dawn Giant' which were obtained from Haramaya distinct and the other 'Titan' Leek variety, from Addis Ababa black market were used as experimental material. It is introduced from France and is popular in eastern Ethiopia. The source of the seed was from Addis Ababa market. This variety is characterized by early maturation, short thick shaft plant and is well adapted to tropical highlands for better yield.

Treatments and Experimental Design

The experiment was conducted using three factorial combinations of three Carentan, 'Dawn Giant' and 'Titan' varieties, three vermicompost (2.5, 3.75 and 5t/h) and two intra-row spacing (15 and 10 t/h). Plots having 40, 30 and 20 t/h vermicompost accommodated 6, 8 and 12 rows, respectively from which the middle 4, 6 and 10 rows had been harvested. The experiment was conducted using RCBD with factorial arrangement in three replications. Gross plot size was 2.4 m x 3 m (7.2 m^2). Spacing of 0.6 m and 1 m were allocated between plots and blocks, respectively.

Proximate Analysis of Nutrient Content of Different Organic Fertilizers

Related Studies

Vermicompost

Sudhakar *et al.,* (2002) conducted a study on the effect of vermicompost application on the soil properties, nutrient availability, uptake and yield of rice which they prove that vermicompost compared to non-ingested soil resulted in significantly better growth and yield of rice has been reported by several workers, (TNAU, 2002).

Arancon and Edwards (2005) conducted a research about the effects of vermicompost on plant growth. Based on their research, they proved that application of vermicompost at lower substitution rates can increase growth and yields of vegetable and ornamental crops. Similarly, vermicomposts can be applied at very low rates 2.5 t/ha or 5 t/ha can significantly increase growth and yields of highly valuable vegetable and fruits crops in the field. The effects of vermicomposts on plants are not exclusively attributed to the quality of mineral nutrition is provided but also to its other growth regulating components such as plant growth hormones and humic acids. Furthermore, the application of vermicomposts in the field enhances the quality of soils by increasing microbial activity and microbial biomass which are key components in nutrient cycling, production of plant growth regulators and protecting plants soil-borne disease and arthropod pest attacks.

Statistical Data Analysis

The parameters considered in this study were subjected to statistical analysis. The data were subjected to analysis of variance (ANOVA) using SAS version 9.2 computer software (SAS, 2009). Mean difference was tested following least significant difference (LSD) procedure at 5% level of probability. Interpretations were made according to Gomez and Gomez (1984).

Data Collection

The data on plant growth and yield related traits were recorded from 10 sample plants randomly sampled from middle rows in each plot. Yield data were recorded from all plants in the middle rows leaving aside plants from the border rows and those at both edges of each row.

Plant height (t/h)

This parameter was measured in centimetres from the ground level to the top of the plant 30 days after transplanting (DAT) and at maturity from15 randomly selected plants.

Days to maturity, Number of leaves per plant, Leaf length (t/h), Leaf width (t/h), Pseudo-stem height (t/h), Pseudo-stem diameter, length of the average width, and length of mature pseudo-stem white + green after harvesting, Pseudo-stem yield (marketable, unmarketable and total yield), and Total fresh matter yield:

Results and Discussion

Days to Maturity

Highly significant differences ($P < 0.01$) were recorded on the number of days to 90 % physiological maturity on the main effects of variety, inter- and intra-row spacing. The number of days taken to reach 90 % physiological maturity for varieties Carentan Giant, 'Dawn Giant' and Titan' leek was 191.50, 191.67 and 199.50 days, respectively (Table 2). Carentan Giant and 'Dawn Giant' varieties matured significantly later than that of Titan'

variety. However, there was no significant difference between varieties Carentan Giant and 'Dawn Giant' also differences among cultivars in time to physiological maturity of leek. In line with this, Ali *et al.,* (1999) reported that as intra-row spacing decreased days to maturity was found to be increased on winter potato.

The main effects of vermicompost showed a highly significant influence ($P < 0.01$) on the number of days to 90 % physiological maturity, the number of days taken to 90 % physiological maturity increases as the vermicompost increases i.e. plots having 20 t/h vermicompost matured earlier than 30 and 40 t/h vermicompost. When vermicompost increases from 20 to 30 and 20 to 40 t/h vermicompost, the maturity period increases by 1.55, 1.79 %.

Plots having 10 t/h intra-row spacing matured 1.78 days earlier than plots having 15 t/h intra-row spacing (Table 3). In this study, it was generally observed that wider intra-row spacing delayed 90 % physiological maturity.

Similarly, Jilani (2004) reported differences among cultivars in time to physiological maturity of onion. As the intra-row spacing increased from 10 to 15 t/h, the days to 90 % physiological maturity increases by 1.60 %.

Plant height

Analysis of variance exhibited significant differences ($P < 0.05$) due to the main effects of variety on plant height at 90 % physiological maturity. The highest height of plant was recorded for variety Carentan Giant (41.24 t/h) followed by 'Dawn Giant' (39.17t/h) while the lowest height was recorded on variety Titan' (37.82t/h). Variety Carentan Giant was significantly different from variety Titan' on plant height while variety 'Dawn Giant' was found with the same level of significance with both Carentan Giant and "Titan" (Table 3). The variation in height might be due to genetic characteristics of the varieties for this trait. Plant height was not affected significantly by the main effects of inter- and intra-row spacing. The non-significant effect of crop density on mean plant height observed in this study might be attributed to the fact that crop density has often, but not always been associated with increased plant height.

Increase in plant population markedly would increase plant height of leek. Plant height at maturity decreased with increasing plant density of leek in four out of five location but no significant differences were observed in one location. All interaction effect also did not influence significantly the mean height of leek varieties. This result was in agreement with Mondal *et al.,* (1986) who reported that genotypes of onion were significantly differed in plant height. The result of the experiment was in line with the findings of Zamil *et al.,* (2010) who reported that the widest spacing enhances growth and height of the plant which was significantly different from narrow spacing.

Leaf Length

The main effects of variety inter- and intra-row spacing on leaf length of leek plants showed significance difference ($P< 0.01$, $P < 0.05$ and $P < 0.01$. Varieties Carentan Giant (39.78t/h) and 'Dawn Giant' (41.50t/h) as compared to 'Titan (46.33t/h). Significant difference was observed between variety 'Titan and the other two varieties. But varieties Carentan and 'Titan found with the same level of significance (Table 3). This might be attributed to the facts that leave length in leek are considering variety characteristics, which is genetically controlled. Previous studies showed that, the differential response to leave length among varieties was distinct.

The highest leaf length was Carentan Giant 43.50 t/h in 40t/h vermicompost followed by 'Titan' 42.9 t/h in 30 t/h vermicompost while the lowest leaf length was 'Dawn 42.17 t/h in 20 t/h vermicompost (Table 3). The 20 and 30 t/h vermicompost were found to be non-significant to each other but they were significantly different from 40 t/h vermicompost. When the vermicompost increased from 20 to 40 t/h, leaf length increased.

The leaf length was 42.07 and 43.67 t/h for 10 and 15 t/h intra-row spacing, respectively which were statistically different to each other. When the intra-row spacing increased from 10 to 15 t/h, the leaf length increased by 3.66 % (Table 3). Therefore, plots having wider inter- and intra-row spacing length significantly later than that of narrower inter- and intra-row spacing. Moreover, Birhanu *et al.,* (2019) and Marschner (2007) reported the non-significant effect of plant population on plant height of chive onion.

Leaf width

The statistical analysis of the data indicated that the main effects of Variety Carentan Giant gave the highest (10.94) leaf width followed by variety Titan (9.66) while 'Dawn Giant' variety gave the lowest (9.04) (Table 3). However, all varieties did not show significant differences with each other

The main effects of vermicompost significantly affect (P < 0.05) leaf width at physiological maturity. As the vermicompost increases from 2.5 to 3.75t/h, the leaf width at physiological maturity significantly increased. The highest leaf width was recorded at 30 t/h vermicompost (10.28) followed by 30 t/h (10.11) while the lowest leaf width (9.06) was obtained from 20 t/h vermicompost.

Significance variation was observed between 2.5t/h and the other vermicompost, however, 3.75 and 2.5t/h vermicompost were found to be non-significant. When the vermicompost decreased from 3.75 to 5 and 2.5 to 3.75, the leaf width at maturity increased respectively (Table 3). The main effects of intra-row spacing also cause significant variation (P < 0.05) on the present leaf width.

Number of Leave per plant

Branching is basically a genetic character and plays an important role in enhancing pseudo-stem yield. The effects of variety, inter- and intra-row spacing (p < 0.01); and the interaction effects of variety x vermicompost and variety x intra-row spacing (p < 0.05) had a significant influence on the number of leave plant^{-1}.

The interaction effect of variety and vermicompost on the number of leaves plant^{-1} was given in Table 4. Variety 'Dawn Giant' at 40 t/h vermicompost gave the highest number of leaves (4.30) while variety Carentan Giant at 20 t/h vermicompost gave the lowest number of primary branches (2.03). The mean number of leaves of two varieties ('Dawn Giant' and Titan') decreased with decreased vermicompost. When the vermicompost increases from 20 to 40 t/h, the number of leaves of varieties 'Dawn Giant' and Titan' increases by 32.09 and 31.76 %, respectively (Table 4). The decreased vermicompost resulted in more plants per unit area and hence less number of leaves plant^{-1} due to more competition for nutrients, light, water and air.

Significant differences were recorded among varieties at all vermicompost. Carentan Giant significantly gave lower number of leaves than the other two varieties at all vermicompost but there was no significant difference between varieties 'Dawn Giant' and Titan' (Table 4). The significant differences among varieties at all vermicompost could be due to the differences in growth habit since varieties 'Dawn Giant' and Titan' relatively have spreading or bushy growth habit than variety Carentan Giant (personal observation). The increase in number of primary branches with decreased plant density consistent with the studies done by Singh *et al.,* (2005) who showed that as density increases the number of primary branches of chive onion decreases.

Yield related trait

Shaft diameter

Shaft diameter plant^{-1} is a key factor for determining the yield performance in allium plants. The productive capacity of leek plant is ultimately considered by the Pseudo-stem diameter plant^{-1}. Analysis of variance showed that varieties significantly differed (P < 0.01) for shaft and diameter plant^{-1}. The highest Pseudo-stem diameter plant^{-1} was recorded for variety 'Dawn Giant' (27.59) followed by variety Titan' (24.88) while the lowest number of pods plant^{-1} was recorded for variety Carentan Giant (17.12) (Table 5). All of the varieties significantly differed with each other. The differences in Pseudo-stem diameter plant^{-1} might have been caused due to varietal differences.

Shaft diameter plant^{-1} was affected significantly (P < 0.01) by different vermicompost and ranged from 21.33 to 24.38 white part pseudo stems. As the vermicompost increases from 2.5to 40 t/h the pseudo-stem diameter plant increases. Significant variation was existed between 2.5 and the other vermicompost but similar significance level were found between 3.75 and 5 t/h vermicompost. Average shaft diameter plant^{-1} was increased by 10.72 and 12.51 % as the vermicompost was increased from 2.5to 30t/h and 2.5 to 40 t/h, respectively (Table 4). Higher shaft diameter plant^{-1} in 40 t/h apart inter-rows might be due to low competition of plants in the field which facilitated more aeration, greater light interception and more photosynthetic activity per individual plant. Islam (1988) also showed that higher yields of Pseudo-stem diameter can be achieved as row spacing is reduced where inter, - and intra-row spacing's are similar.

Effect of intra-row spacing on pseudo-stem diameter plant^{-1} was significant (P < 0.05). Higher average pseudo-stem diameter plant^{-1} (24.06 ps. stems) was noted in 15 t/h intra-row spacing and the lower pseudo-stem diameter plant^{-1} (22.34 stems) was recorded in plots with 10 t/h intra-row spacing (table 5).

The statistical analysis of data showed that the main effects of varieties and inter-intra row spacing significantly increased with three varieties (Carentan up

to Titan) and intra-row spacing affect the pseudo-stem length pseudo-stem parts, as shown in Appendix Table 3. Various studies result conducted in different countries reported that shank (shaft) length increases with decreasing inter-intra spacing. This is indicated that the main effects of variety were influence the shaft length yield of leek varieties. However, the highest shaft yield of 19.07t/h green part had occurred for variety Titan followed by variety Dawn (16.41t/h) while the lowest seed yield was obtained for variety Carentan (15.93t/h) (Table 5) and have a response in shaft length of the green part of the leek.This result was in not agreement with that of Baker (1998) also reported that in the narrow intra-row spacing of leek plants were decrease in pseudo-stem length could be due to the presence of high competition for growth factors at wider spacing.

Fresh matter Yield

As indicated in the Table 4, the biological fresh matter yield of leek significantly (P<0.05) varied due to the main effects, elucidate that vermicompost normal caused a highly significant effect (p < 0.01) on the biological fresh matter yield of leek varieties. The highest average biological Fresh matter yield Titan was recorded in 2.5t/h vermicompost followed by 30 t/h inter-rows with average biological fresh matter yield value of (93.80) while the lowest yield (72.70) was recorded in 40 t/h inter-rows (Table 5). There was high statistically significant difference between 30 and 40 t/h vermicompost.

Dry matter content

The main effect of varieties and inter- intra row spacing and their interaction did not significantly affect the dry matter content of leek pseudo-stem as shown in Table 2.The dry matter content in the (1.73%) varieties (Carentan up to Titan) plots and under closer spacing might be slightly lower because of the competition for nutrients which is needed for vegetative growth.

The major shaft lengths have uniformity in shape, sizes and non-significant difference observed in the dry matter content of leek pseudo-stem. The increased harvest index of variety 'Dawn Giant' with decreased vermicompostis consistent with Baker (1998) and Mirazaei *et al.,* (2010) who reported that chives types of onion were most responsive to increased population for total dry matter, Getachew *et al.,* (2013) found high plant population to be associated with low dry matter content. It then rose to a peak at 3.75 but then fell with a further increase in plant spacing. He thought that at low plant spacing, there was a high competition for light and other important resources.

Marketable and Unmarketable pseudo stem

The main effects of nitrogen rates and interaction effects of varieties and inter- intra row spacing did not show significant effect on the number of unmarketable pseudo-stems of leek. On the other hand, similar to the number of marketable pseudo-stems was highly significantly affected (P<0.01) by the intra row spacing and also the number of unmarketable pseudo-stems was non-significant effects (P<0.01) by the intra row spacing.

Number of shaft per plant is a key factor for determining the yield performance in allium plants. The productive capacity of leek plant is ultimately considered by the number of pods plant^{-1}. Analysis of variance showed that varieties significantly differed (P < 0.01) for number of stems plant^{-1}The highest number of stems plant^{-1} was recorded for variety 'Dawn Giant' (27.59) followed by variety 'Titan' (24.88) while the lowest number of stems plant^{-1} was recorded for variety Carentan Giant (17.12) (Table 6). All of the varieties significantly differed with each other.

Number of shaftplant^{-1} was affected significantly P < 0.01) by different vermicomposting ranged from 21.33 to 24.38 pseudo stem (shafts). As the vermicompost increases from 20 to 40 t/h the number of shafts per plant increases. Significant variation was existed between 20 and the other vermicompost but similar significance level were found between 3.75 and 40 t/h vermicompost. Average number of shaftplant^{-1} was increased by 10.72 and 12.51 % as the vermicompost was increased from 20 to 3.75t/h and 20 to 40 t/h, respectively (Table 6). Higher number of shaftplant^{-1} in 40 t/h apart inter-rows might be due to low competition of plants in the field which facilitated more aeration, greater light interception and more photosynthetic activity per individual plant.

Total Biological Yield

The productivity of a crop is largely determined by the biological yield. Production of large amount of biomass is among one of the attributes of seed yield. Variety 'Dawn (454.82 kg ha^{-1}) and 'Titan' (427.93 kg ha^{-1}) had the highest biological yield whereas variety Carentan Giant had the lowest biological yield (147.90 kg ha^{-1}) (Table 6). However, all varieties showed statistically non-significant differences.

Table.1 Shows the micronutrient found in vermicompost, cow manure, and chicken dung.

Fertilizer	Copper (Cu)	Iron (Fe)	Manganese (Mn)	Zinc (Zn)
Vermicompost	0.70%	15.10%	9.30%	1.20%
Cow manure	0.0002%	0.5%	0.01%	0.01%
Chicken dung	0.036%	0.52%	0.27%	0.32%

Table.2 Shows the macronutrient found in vermicompost, cow manure, and chicken dung.

Fertilizer	Nitrogen (N)	Potassium (P)	Phosphorus (K)	Magnesium (Mg)	Sodium (Na)	Calcium (Ca)
Vermicompost	23%	11%	22.5%	25.21%	2.15%	12.10%
Cow manure	8.4%	4.7%	2.8%	2.6%	0.2%	6.2%
Chicken dung	12.1%	10.1%	9.2%	7.6%	0.48%	6.2%

Table.3 Mean values of Leaf length, days to 90 % physiological maturity (DM), Leaf width and Plant height (PH) as affected by the main effects of variety, and Vermicompost.

Treatments	Leaf width (cm)	Leaf length (cm)	DM (days)	PH (cm)
Variety				
Carentan Giant	10.94a	39.78c	191.50a	49.24a
'Dawn Giant'	8.04c	48.50a	191.67a	39.17b
Titan'	9.66b	46.33b	199.50b	37.82b
LSD (5%)	0.62	0.89	1.32	2.23
Vermicompost (t/h)				
2.5	10.11b	42.17b	129.50b	39.47
3.75	10.28a	42.94ab	121.22a	38.97
5	9.06c	43.50a	122.95a	39.80
LSD (5%)	0.17	0.89	1.32	Ns
C.V (%)	9.95	3.08	1.76	8.34

Means with the same column followed by different letters are significantly different according to LSD test at 5 % probability level. Ns=non-significant; CV (%) =coefficient of variation

Table.4 Mean values of number of Leaves per plant as affected by interaction of variety and vermicompost.

Vermicompost(t/h)	Number of Leaves per plant		
	Variety		
	Carentan Giant	'Dawn Giant'	Titan'
2.5	12.03d	12.92c	12.90c
3.75	12.35d	13.93ab	13.57b
5	12.47cd	14.30a	14.25a
LSD (5%)		0.54	
C.V (%)		13.25	

Means with in rows and columns followed by different letters are significantly different according LSD test at 5 % probability level. CV (%) =coefficient of variation

Table.5 The main effects of varieties and inter- intra-row spacing on shaft diameter, biological fresh yield weight (BFMY) and dry-matter content of leek

Treatment	Pseudo-stem diameter	Pseudo-stem length	Fresh Matter (g plant^{-1})	Dry matter (%)
Carentan	38.18	5.92b	72.70^{d}c	10.96
Dawn	29.62	6.96b	82.9^{ab}	11.27
Titan	26.84	9.96a	93.80^{a}	11.15
LSD(0.05)	11.34	14.04	26.60	NS
Vermicompost (t/h)				
2.5	28.38	5.78	88.10	11.91
3.75	27.59	5.72	78.60	10.83
5	25.58	6.38	70.40	11.21
LSD(0.05)	02.80	NS	11.01	NS
CV (%)	13.3	16.2	35.4	17.3

Means followed by the same letter within a column are not significantly different at 5% level of significance; NS= not significant.

Table.6 Mean values of number of Marketable per plot, number of unmarketable shaft, biological yield and shaft yield as affected by the main effects of variety, vermicompost (t/h) and intra-row spacing.

Treatments	NM	NUMPS	TBY (kg/ha)	TY (kg/ha)
Variety				
Carentan Giant	17.12c	1.06	137.90	821.77
'Dawn Giant'	27.59a	1.07	454.82	911.50
Titan	24.88b	1.09	427.93	1026.68
LSD (5%)	1.58	Ns	Ns	Ns
Vermicompost(t/h)				
2.5	21.33b	1.06	863.23a	2340.33a
3.75	23.89a	1.08	167.55b	1800.45b
5	24.38a	1.07	899.88b	1619.16b
LSD (5%)	1.58	Ns	98.51	250.89
Intra-row spacing (t/h)				
10	22.34b	1.06	3599.85a	2081.65a
15	24.06a	1.08	3.7520.58b	1758.32b
LSD (5%)	1.29	Ns	325.38	204.85
C.V (%)	10.06	9.20	17.77	19.29

Means with the same column followed by different letters are significantly different according LSD test at 5 % probability level. Ns=non-significant; CV (%)=coefficient of variation

The decrease in biological yield due to low branching habit and low number of pods per plant of variety Carentan Giant might be compensated by the increased in other parameters such as plant height, seed weight and stem thickness.

The biological yield per hectare given in (Table 6). Reveal that a highly significant difference ($P < 0.01$) was obtained due to the main effects of inter- and intra-row spacing (Appendix Table 2). As the vermicompost increases, the biological yield also increases and hence, the highest biological yield 863.23 kg ha^{-1}) was recorded on 2.5t/h vermicompost followed by 3.75t/h with a yield of 167.55 kg ha^{-1} while the lowest biological yield (899.88 kg ha^{-1}) was obtained from 40 t/h vermicompost (Table 6).

Vermicompost having 2.5 t/h was significantly different with plots sown 3.75 and 5 t/h vermicompost but non-significance effect was recorded between 3.75 and 40

vermicompost. The biological yield was increased by 24.94 and 18.01 % when vermicompost was changed from 40 to 20 t/h and 3.75 to 20 t/h, respectively.

Biological yield showed a highly significant variation ($P < 0.01$) due to intra-row spacing and maximum average biological yield of 599.85 kg ha^{-1} was recorded in the plots with 10 t/h intra-row spacing and lower biological yield of 020.58 kg ha^{-1} was recorded in plots with 15 t/h intra-row spacing. Moreover, Gan *et al.,* (2003) concluded that increasing yield of onion at high density and they found strong positive relationship between total yield and plant population densities. Bahr (2007) also reported that high plant density (3.75 plants m^{-2}) gave higher seed yield as compared to low plant density (26 plants m^{-2}) in leek.

Pseudo-stem yield

Pseudo-stem yield and its transformation into economic yield is the ultimate outcome of various physiological and morphological events occurring in the plant system. Pseudo-stem yield of a variety is the result of interplay of its genetic makeup and environmental factors in which plant grow. The main effects of variety did not influence the pseudo-stem yield of leek varieties. However, the highest stem yield of 1026.68 kg ha^{-1} had occurred for variety 'Titan' followed by variety 'Dawn Giant' (911.50 kg ha^{-1}) while the lowest stem yield was obtained for variety Carentan Giant (CG), (821.77 kg ha^{-1}) (Table 6).

The decreased in shaft yield due to short shaft habit and stunt of shaft per plant for variety Carentan Giant variety might be compensated by other parameters such as stem weight. This might be the reason for the non-significant effect of shaft yield among varieties. The interaction effects of all treatment combinations for this parameter were also non-significant. In line with this result, Brittain (1988c) found that narrow vermicompost (3.75t/h) gave the highest seed yield as compared to wider spacing of 45 and 60 t/h on leek.

The main effects of inter- and intra-row spacing caused a highly significant effect ($p < 0.01$) on the total yield of leek varieties. The highest average total yield (2340.33 kg ha^{-1}) was recorded in 20 t/h vermicompost followed by 3.75t/h inter-rows with average total yield value of 1800.45 kg ha^{-1} while the lowest yield (1619.16 kg ha^{-1}) was recorded in 40 t/h inter-rows (Table 6). But there was no statistically significant difference between 3.75 and 40 t/h vermicompost. The total yield was decreased by 23.07 and 30.81 % when vermicompost was increased from 20 to 30 t/h and 20 to 5t/h vermicompost, respectively (Table 6). It might be concluded that 2.5t/h vermicompost is optimum for maximum light interception and photosynthetic activity of leek varieties per unit area.

The higher shaft yield (2081.65 kg ha^{-1}) was recorded in 10 t/h intra-row spacing and lower yield of 1758.32 kg ha^{-1} was recorded in plots with 15 t/h intra-row spacing (Table 6). When intra-row spacing was increased from 10 to 15 t/h, the yield was decreased by 15.53 %.

Generally this study, varieties of leek that increase in total yield on individual basis due to the favor of spacing did not compensate the increase in total shaft yield due to the favor of population per unit area basis. Thus, from the forgoing results, total yield can be substantially improved by the use of 2.5t/h vermicompost in was conducted during 2022 to 2023 cropping season at Dalbo WogeneKebele, Sodo Zuria Woreda, in Wolaita Zone, Southern Ethiopia and similar areas in the country. It might be concluded that 2.5t/h vermicompost is optimum for maximum light interception and photosynthetic activity of leek varieties per unit area.

However, this tentative generalization, based on one season at one location, required confirmation with further studies to give a valid recommendation. Therefore, to increase the productivity of leek, future research directions have to be focused on verifying the present investigation across years and locations in order to reach on a conclusive impact of plant spacing by taking the economic aspect as well.

Future research directions should also focus the effect of method of sowing on the densities of leek varieties since the research was done on flat method of sowing. But, the crop at was conducted during 2022 to 2023 cropping season at Dalbo Wogene Kebele, Sodo zuria Woreda is mainly sown with ridge method of planting; and it is clear that, there is a space left in between beds which finally reduces the vermicompost.

This might have influential effects on the densities of leek varieties and therefore, it is necessary to conduct an experiment on time of planting, economics analysis, and different method of sowing to examine and come up a conclusion whether planting time has a significance influence on vermicompost of leek varieties. In addition to this, other varieties of leeks including high shaft length type having different canopy architecture should be conducted.

References

Aklilu, S., 1997. Onion research and production in Ethiopia. *Acta Horticulture*, 433: 95-98

Bahr (2007) Leek production (June, 2007), http://www.edis.ifas.ufl/ English/crops/facts/ (07. Aug. 2005). Competition and crop performance in a Leek-cropping system. Crop science, 31:164-724

SZWARDO (Sodo Zuria of Agriculture and Rural Development) (2011). Analysis of production of ginger.*Unpublished data*.

Baker, R. 1998. Leek production (July, 1998), http://www.gov.on.ca/OMAFRA/english/crops/facts/ (07. Aug. 2005).

Baumann, D. T., Bostioans and M. J. Kropff, 2001. Competiton and crop performance in a Leek-celery intercropping system. Crop science, 41:764-774.

Berhanu Debele, 1980. The physical criteria and their rating proposed for land evaluation in the highland region of Ethiopia. Land use planning and regulatory department, Ministry of Agriculture. Addis Ababa, Ethiopia.

Brewster, J. L., 1994. Onions and Other Vegetable *Alliums*. CABI Publishing. Wallingford, UK. 236p.

Bouyoucous, C. J., 1951. Reclamation of the hydrometer method for making mechanical analysis of soils. *Agronomy J*ournal 43: 434-438.

Chapman, H. D., 1965. Cation exchange capacity by ammonium saturation. Method of soil analysis. American Society of Agronomy. Black, C. A., L. E. Ensminger and F. E. Clark (Eds.). Madison Wisconsin, USA.

CSA (Central Statistical Authority), 2008. Report on Land Utilization. Statistical Bulletin, Vol.417. Addis Ababa, Ethiopia.341p.

Dawit Daliga, 2010 Factors influencing chemical application in plant nutrient up take and performance of weed spp in case of Areka. AMsc. Thesis presented to the Haramaya University Ethiopia.12p.

Decoteau, D. R., 2000. Vegetable Crops. *Prentice-Hall, inc. USA. 561p.*

FAO (2007). *Agriculture Production and Trade Statistics*. Food and Agriculture Organization of the United Nations, Rome (available at: http://faostat.fao.org).

FAOstat, 2010. FAO. Production year Book for India vol 67 Food and Agriculture Organization of the United Nations, Rome Italy. 17: 11-12.

Greenwood, D. J., D. A. Stone and Karpinets, T. V. 2000. Dynamic model for the effects of intra raw spacing, fertilizer P on crop growth, and soil P in arable cropping: Experimental test of the model for field vegetables. *Annals of Botany*, 28: 93-206.

Hanelt, P., 1990. Taxonomy, evolution and history. In: Rabinowitch, H. D. and J. L. Brewster (eds.), Onions and Allied Crops vol.1. CRC Press, Boca Raton, Florida, pp. 1-26.

Islam, M., 1988. Effects of different doses of nitrogen and plant spacing on the growth and yield of onion (*Allium cepa* L.). M. Sc. (Ag) Diss., Dept. of Horticulture, BAU, Mymensingh, Bangladesh.

Jilani, M. S. 2004. Studies on the management strategies for bulb and seed production of different cultivars of onion (*Allium cepa* L.).PhD thesis, Gomal University, Dera Ismail Khan.pp.1-499.

Jackson, M. L., 1958. Soil chemical analysis. Prentice Hall, Inc., Engle wood cliffs, New Jersy.

Lemma, D. and Herath, E., 1992. Agronomic studies in Alliums Presented at 2nd National *Horticultural work Shop,* December, 1992. IAR, Addis Ababa.

Meer W. J. Ridgman and Hanley, F. 1990. The effects of fertilizers on the bulbing of formation Onion. *Journal of Agricultural Sciences* 65: 159-169.

Metasebia, M. and H. Shimelis, 1998. Proceeding of the 15th Annual Research and Extension Review Meeting, 2 April 1998. Alemaya Research Centre. Alemaya University of Agriculture. pp. 216-235.

Mondal, M. F., 1985. Studies on the control of bulbing in onion (*Allium cepa* L.).PhDThesis, University of Birmingham, UK.

Marschner, H. 1995. Mineral Nutrition of Higher Plants, 2nd ed. Academic press.London.196p.

Olsen, S. R., F. S. Cole, and L. A. Dean, 1954. Estimation of Available Phosphorus in soils by extraction with Sodium bicarbonate. USDA Circ. No. 939, Washington DC.

Simon, P. W., 1992. Onion Improvement Newsletter for 1991.Dept of Horticulture, Universityof Wisconsin, Madison, Wisconsin, USA.

Singh, A., R. Prasad and R. K. Sharma, 2005. Effect of plant type and population density on growth and yield of chive onion.*Journal of Agriculture Sciences U.K.,* 110 (1): 1-3 (Field Crop *AbstAI*(2) :9056,1988).

Tekalign Tadesse, 1991. Soil, plant, water, fertilizer, animal manure and compost analysis. Working Document N° 13. International Livestock

Research Center for Africa (ILCA), Addis Ababa.

Theunissen, J., Schelling, G. 1998. Infestation of leek by thrips tabaci as related to spatial and; temporal patterns of undersowing, Bio, Control, 43, 1: 107-119.

Walkley, A., and I. A. Black, 1934.An example of the degitiareff method for determining soil organic matter and a proposed modification of the chromic acid titration method. *Soil Sciences,* 34: 29-38.

Vohra, S. B., M. Rizaman and J. A. Khan., 1994.Medical uses of common Indian vegetables.*Planta Medea*., 23(4): 381-393.

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