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Promotion of Onion Seed Production Technologies for Improving Productivity in Upper and Middle Awash Irrigated Areas

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Abstract:
The onion (Allium cepa L.) is a member of the family Alliaceae and the most widely grown biennial vegetable crop that needs quality planting material for its successful production. For the supply of seeds, the informal sector is playing a significant role in reaching many farmers. Most of the demand for onion seeds is either met by local supplies through an unorganized market system or by imported seeds through an informal trend. Therefore, this experiment was conducted at two kebeles in each of the Fentale and Amibara districts on small-scale irrigation in 2021 to demonstrate Nafis and Nafid onion seed production technologies through a participatory approach. The experiment was done on a systematically selected agro-pastoralist. The field experiment was laid out in a single plot having an area of 10 by 10 m2. Two released onion varieties, Nafis and Nafid, were used in this experiment. Planting date, seed yield per plot and hectare, number of stakes per plant, stake diameter, length of primary stake, and numbers of umbels per plant were all collected. Using SAS software, version 9.0, collected data were analyzed for an independent two-sample t-test. The yield performance of demonstrated onion varieties was computed using an independent-sample t-test to compare the performance of average yield differences between the two varieties. Accordingly, a significant difference was observed in the average seed yield for varieties Nafis (10.72 q ha-1) and Nafid (9.17 q ha-1). It is concluded that the Nafis variety really does have an advantage of 1.55 q ha-1 seed yield over the Nafid variety. Therefore, it suggests that the Nafis variety will increase their seed yields when aggro-pastoralists need to produce onion seed.

Keywords: Onion, Agro pastorals, Seed yield, KOPIA, Demonstration

INTRODUCTION

The bulb onion (*Allium cepa* L., *Alliaceae* family) originated in the region comprising Afghanistan, Iran, and the southern portion of the former Soviet Union. The supposed onion ancestor, onion from Central Asia, most likely migrated to the Near East, and areas around the Mediterranean Sea are secondary centers of development (Malik M.N., 2000). The majority of germplasm introduced and developed in Ethiopia has its origins in India, Brazil, Sudan, and Italy. The genus Allium is highly diverse and contains more than 600 species, among them the edible species A. fistulosum (bunching onion, Japanese onion, Welsh onion), A. sativum (garlic), A. ampeloprasum (leek), A. schoenoprasum (chives), and A. tuberosum (Chinese chives). Allium cepa is the most widely cultivated of these species. Bulb onion has been cultivated for more than 5000 years and is not known to exist in the wild, though the closest wild relatives are A. galanthum and A. vavilovii (Hanelt, 1990), both of which can be found in its areas of origin.

Onions are a very important vegetable crop as a source of food for human beings. It is valued for its distinct pungency and forms an essential ingredient for flavoring varieties of dishes, sauces, soups, sandwiches, snacks as onion rings, etc., and is a cash crop both for local and export earnings and serves as an area of employment for many people due to its intensive culture. Dry onions are indispensable kitchen vegetables in every home and are typically used as an ingredient in many dishes and salads. Numerous scientific studies suggest that onions and their relatives can be used to treat, reduce, or prevent a variety of health problems, including cardiovascular disease, diabetes, cancer, asthma, antibiosis, and prebiotic effects (Desjardins, 2008). Allicin and alliin in the onion whet the appetite, facilitate digestion and serve as a regulatory impact on the intestines. Onions have vitamins (A, B1, B2, C, nicotinic acid, pantothenic acid) and important substances such as protein, calcium, phosphorus, potassium, and traces of Fe, Al, Cu, Zn, Mn, and I. Furthermore, it has anti-fungal and anti-bacterial properties and contains an acrid volatile oil with a pungent smell. Its oil is rich in sulfur (Augusti, 1990).

Ethiopia has favorable and diverse agro-ecological conditions for growing a wide range of fruit and vegetable crops. Vegetables (onion, tomato, pepper, kale, etc.) are the most popular crops with varied food and culinary uses, providing vitamins and minerals vital for a balanced and healthy diet that helps to prevent deficiencies caused by nutritional imbalance. Vegetables, including onions, can also protect our bodies from serious diseases. Besides, the production of vegetables can create job opportunities, particularly for women, youth, and poor households because of its labor-intensive nature. Furthermore, they can give a high yield per unit area compared to cereals and hence generate a high income for farmers due to their high market value and profitability.

In Ethiopia, onions rank third in terms of area coverage, trailing only red pepper and kale, and kale is second in production (CSA, 2018). The same report indicated that 880,638 smallholder farmers produced about 293,888 tons of onions from 31,673.21 hectares of land in a year. Moreover, annually, Ethiopia earns more than 2.6 million USD from the export of fresh and chilled onion and shallot products. Hence, by considering the economic, nutritional, and social significance of the crop for Ethiopians, the Ethiopian Institute of Agricultural Research has identified onion as one of the priority crops in research to improve yield and quality in order to satisfy the demands of local consumption and export markets. Through years of research, improved varieties (seven open pollinated that include Adama Red, Bombay Red, Melkam, Nasik Red, Nafis, Robaf, and Nafid varieties) and corresponding production technologies have been recommended, which have contributed to the improvement of production and productivity of the crop in the country. The area covered and productions of the crop have been increasing for the last six years (CSA,2018). The area under onion was only 21,865 ha in 2013; whereas, it has now increased to 31,673.21 ha in 2018, which is about a 45% increment. Similarly, the production was 219,189 and 293,888 tons in 2013 and 2018 respectively, which accounted for a 34% increment.

However, still, the national average yield is low when compared to the yield potential of released varieties, onion-producing countries, and the world average. Besides, despite the increase in cultivated areas and production, Ethiopia is importing a significant amount of fresh onion bulbs from Sudan since the demand for the crop and its local production are not balanced. The low productivity could be attributed to the limited availability of quality seeds and associated production technologies used, among others.

In Ethiopia, the productivity of onion seeds is much lower than in other African countries (Nikus, O. and Fikre, M., 2010). The yield of onion seed ranges from 1000–1300 kg ha-^{1} (Lemma et al., 2006) and 75.15–115.75 kg ha-^{1} (Teshome et al., 2014; Tamrat, 2006) in Ethiopia, while in other countries it ranges from 828–1446 kg ha-1 (Aminpour, R. and Mortzavi, B. A., 2004). The area coverage and production across the country are increasing from time to time, and most of the recently released varieties account for the largest area coverage (Ahmed, I. H. and Abdella, A. A., 2006). Despite an increase in the area of coverage, the productivity of onion varieties in Ethiopia is much lower than the expected production level. The low productivity could be attributed to the limited availability of quality seeds and associated production technologies used, among others. Onion cultivars vary in their susceptibility to flower stalk development depending on climatic conditions and their genetic background (Shimeles, A., 2000).

For the supply of seeds, the informal sector is playing a significant role in outreaching a large number of farmers. Most of the demand for onion seeds is either met by local supplies through an unorganized market system or imported seeds through an informal trend. The formal sector, Ethiopian Seed Enterprise (ESE), is not generally supplying onion seed. Most amounts are catered for small-scale irrigation users by public sector organizations such as the Ethiopian Institute of Agricultural Research (EIAR)-Werer Agricultural Research Center as pre-scaling out activities (Nigussie A. *et al.*2015). Therefore, this research seeks to demonstrate seed production technologies of onion in small-scale irrigation are of upper and middle awash.

MATERIAL AND METHODS

Description of the Study Area

The experiment was conducted at Beadamo and Bonta (Amibara district) and Sareweba and Gare-dima (Fentale district) of Afar and Oromia region, respectively in 2021 cropping season. Bedehamo and Bonta are located in the Afar National Regional State, Zone-3, Amibara district, which is 280 km in the north east of Addis Ababa. It is located at 9° 60′ N latitude and 40° 9′ E longitude with an altitude of 740 meter above sea level (m.a.s.l.). The mean annual temperature is 34 ^{O}C, while the mean annual rainfall and evapotranspiration are 560 and 2600 mm, respectively. The weather is very long hot and dry and rainfall is very erratic. Sareweba and Gare-dima are located in the Oromia National Regional State, East Shewa Zone, Fentale district, located at about 198 km East of Addis Ababa in the Great Rift Valley lies between 8 0 54' north latitude and 360 23' to 390 54' east longitude. The average annual rainfall is 486 mm. It has a yearly maximum temperature range from 32 to 42 degree centigrade while the minimum temperature ranges from 10 to 22 degree centigrade.

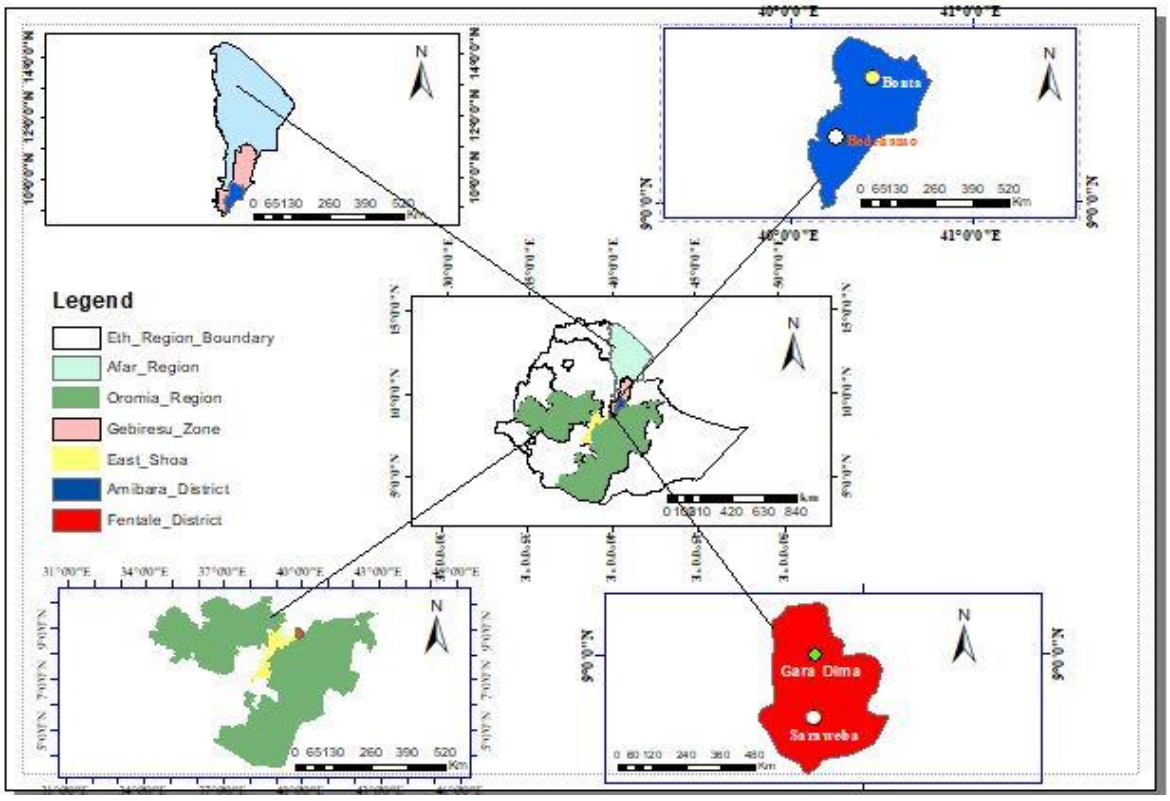

Figure 1: Location map of the study area

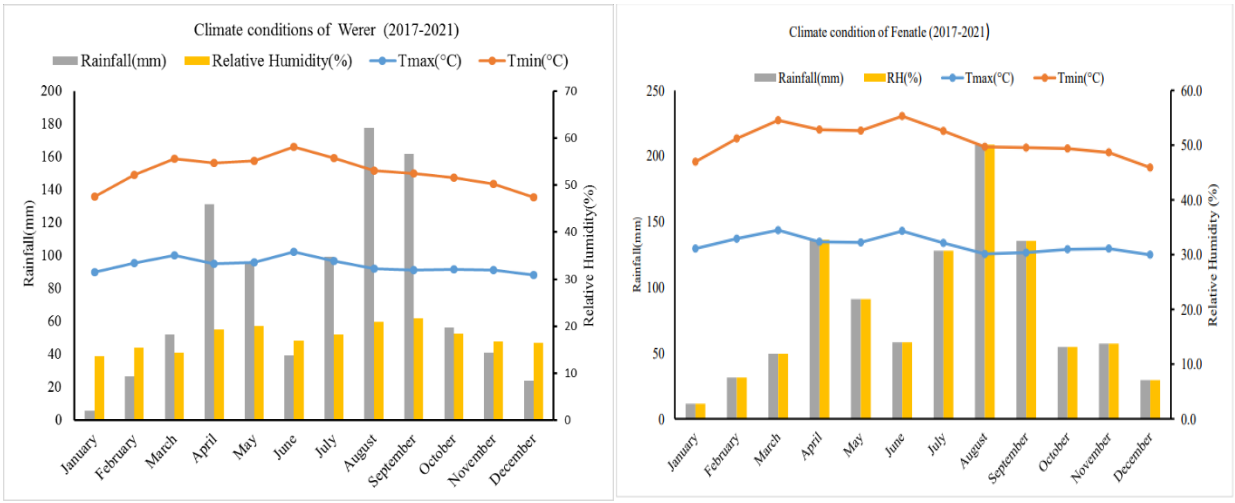

Figure 2: Climate condition of the study area

Participatory Research Group (PRG) Setup

The experiment was done on systematically selected agro-pastoralist. Participatory Research Group (PRG) was formed through the help of development agents and agricultural experts of the kebeles following the appropriate procedures involving innovative agro pastorals. The PRGs was had member of about ten agro-pastorals that include both men and women. Training was given to the PRG members, developments agents and agricultural experts of the districts about onion seed production techniques. All management practices were performed as per the research recommendation as per training. Finally, all PRG actors including agro pastoralists, researchers and development agents was let to collect seed and made their own evaluation and conclusion.

Field Experiment

The field experiment was laid out in single plot having the area of 10 by 10 m^2. Two released onion varieties: Nafis and Nafid were used in this experiment. The seed of each variety were sown on nursery bed for seed bulb production. The onion seedlings of the targeted varieties was transplanted to the field at 45-55 days after sowing in double rows of 40 x 20 x 5 cm, spacing which includes water furrows, rows on the bed and between plants, respectively.

The bulbs were harvested and replanted for breeder seed production in October at Werer Agricultural Research Centers after being stored for one month. Bulbs which were healthy, free from any mechanical and physiological defects, true-to-type and uniform bulbs of about 5cm diameter were selected for seed production and demonstration. Seed bulbs were planted in double rows of 50 x 30 x 20 cm spacing which includes water furrows, rows on the bed and between plants, respectively during the off-season by irrigation. The area will be divided into block/s of a 10m width and 10m length and the space between blocks were 1.5m.

NPS were applied at the rate of 242 kg ha^{-1} before transplanting and urea at the rate of 100 kg ha^{-1} were applied at side dressed in split application: 50% after 21 days of transplanting and the remain 50% at one and half month after transplanting. Irrigation was applied at the interval of every 5 days for the first 4 weeks and every 7 days then after (Lemma and Shimeles, 2003). Every standard cultural practice was followed regularly as recommended. Diseases and insect management practices were made according to the recommendations given for onion seed production in the country.

Harvesting was done when the umbel/head exposes some black seeds but before shattering by hand. After harvest, the heads were dried on canvas under ventilated shed or sun according to onion seed harvesting procedures.

Data Collection procedures

Data on yield and yield related traits were collected: planting date, Seed yield $plot^{-1}$ and hectare, number of stake $plant^{-1}$, stakes diameter (cm), length of main stake (cm), number of umbels $plant^{-1}$.

Statistical Analysis

Collected data were used to carry out Analysis of independent two sample t-test using SAS software, version 9.0 (SAS Institute Inc., 2002). Mean comparison were computed by comparing of the mean of one sample with the mean of another sample to see if there was a statistically significant difference between the two varieties at 95% of confidence interval.

RESULT AND DISCUSSION

Yield and Yield-Related Parameters

Seed Yield Performance:

The yield performance of demonstrated onion varieties were illustrated in figure 3 and 4 for Amibara and Fentale districts, respectively. An independent-samples t-test was conducted to compare the performance of average yield differences between the two varieties (Table 1). There was a significant difference in the average seed yield for Nafis variety (M=10.72 q ha^{-1}, SD=0.78) and Nafid variety (M=9.17 q ha^{-1}, SD=0.59); t (18) = -5, p = <0.0001. This result suggests that Nafis variety really does have an advantage of 1.55 q ha^{-1} seed yield over Nafid variety. Specifically, it

suggests that when agro-pastoralists produce onion seed, Nafis variety increase their yields. The difference in seed yield might have been due to the genetic differences. The current result was in line with the result of S. Ahmed *et al*., (2020) in which significant variation in respect of seed yield per hectare (kg) of two varieties of onion were identified. That was the variety Kalash Nagari, which gave a significantly higher seed yield per hectare (630 kg ha-^{1}) in comparison to the variety Taherpuri (270 kg ha-^{1}).

Similarly, an independent-samples t-test was conducted to compare the yield differences of the two varieties across the two locations (Table 1). Accordingly, there was non-significant difference in the yield of both Nafid and Nafis varieties at Amibara districts (M=9.79 q ha^{-1}, SD=0.99) and Fentale districts (M=10.11 q ha^{-1}, SD=1.12); t (18) = -0.67, p = 0.51. This result suggests that there is no statically difference between the two locations and the only difference between the two varieties were independent of locations that perhaps either due to the similarity of agro ecology of the two locations or the adaptability of varieties to a wide range of environmental conditions (Tesfaye et al. 218 and Khokhar et al, 1990).

Table 1: T-test of yield difference among the varieties and locations

t-test of variety difference							
Statistics							
Variety		**N**	**Mean** (q ha^{-1})		**SD**		**SE**
Nafid		10	9.17		0.59		0.19
Nafis		10	10.72		0.78		0.25
Equality of Variance							
F value			**Sig**				
1.76			0.41				
t-test for equality of Means							
Method	**t**	**Df**	**Sig (2 tailed)**	**Mean Diff** (q ha^{-1})	**SE Diff**	**95% CI of Diff**	
						Lower	**Upper**
Pooled	-5	18	< 0.0001	-1.55	0.3	-2.2	-0.9
Satterthwaite	-5	16.7	0.0001				

t-test of location difference						
Statistics						
Districts		**N**	**Mean** (q ha^{-1})	**SD**		**SE**
Amibara		10	9.79	0.99		0.32
Fentale		10	10.11	1.12		0.35
Equality of Variance						
F value			**Sig**			
1.26			0.74			
t-test for equality of Means						
t	**Df**	**Sig (2 tailed)**	**Mean Diff** (q ha^{-1})	**SE Diff**	**95% CI of Diff**	
					Lower	**Upper**
-0.67	18	0.51	-0.32	0.47	-1.31	0.68
-0.67	17.8	0.51				

Yield Related Parameters

The most important components for onion seed production were presented in Table 2. These are number of stalks per plant, length of main stalk, number of umbels per plant, number of flowers

per umbel, umbel diameter, number of seed per ample, seed yield per umbel, seed yield per plant, and stalk diameter.

Number of Stalk Per Plant:

The analysis of independent sample t-test indicates that the number of stalks per plant significantly differs. It ranges from 3 to 6 with an average of 4.2 for variety Nafid and 4 to 6 with an average of 5.1 for variety Nafis. The overall means for number of stalks per plant was 4.6. This study in line with the study Asaduzzaman *et al,* 2012 that revealed that the number of flowering stalks per plant was significantly high (3.63) in the large sized bulb (15±2g) whereas the minimum (2.45) in small sized bulb 5±2g

Length of Main Stalk (cm):

The analysis of independent sample t-test showed significantly higher length of main stalks 45cm over variety Nafid and 64cm over variety Nafis. The overall mean for length of main stalk was 59.65 cm. This result in line with the result of Pushpendra S. *et al.,* 2017 in which plant height varied from 41.7 to 53.4 cm with an overall mean 47.67.

Number of Umbels Per Plant:

The mean number of umbels per plant was lowest (3) and while it was highest (13) for Nafid variety. Similarly, the highest and lowest of number of umbels per plant were 5 and 11 for Nafis variety with overall mean of (7.2). The current finding is in line with the work of Geetharani and Ponnuswamy (2007) and Ashrafuzzaman *et al*. (2009) on onion plants in which large bulbs may contain higher food reserves and be responsible for the higher number of flowering stalks per plant.

Number of Flowers Per Umbel:

Both varieties were significantly different from each other by mean numbers of flowers per umbel. Nafis variety was produced the highest (395.80) mean numbers of flowers per umbel while the lowest mean numbers of flowers per umbel (285.80) were observed by variety Nafid with an overall mean of 340.80.

Stalk Diameter:

The lowest mean flower stalk diameter (1.16 cm) was achieved for variety Nafid which was statistically similar to the highest mean flower stalk diameter (1.19 cm) of Nafis.. The finding is similar to the results of Pandey *et al.* (1994) who obtained larger flower stalk diameter from wider intra-row spacing.

Umbel Diameter:

The mean umbel diameter was significantly differing and it ranged from 1.9 cm to 3.6 cm for variety Nafid and 2.5 cm to 4.2 cm for variety Nafis with an overall mean of 2.78 cm. The highest umbel diameter (3.04 cm) was recorded from Nafis variety and was significantly different from Nafid variety which was lowest (2.52 cm). this result was in line with the result of Mollah *et al.* (2015) recorded umbel diameter with a range of 6.9 cm to 3.0 cm. Teshome *et al.* (2014) also reported umbel diameter with a range of 6.0 cm to 4.8 cm.

Number of Seed Per Umbel:

The two varieties were showed significantly difference in number of seeds per umbel. The mean number of seeds per umbel ranged from 182 to 280 over variety Nafis. On the other hand, minimum mean number of seeds per umbel 100 to 222 was recorded from variety Nafid with an average of 199.55. Similar with current finding Teshome *et al*. (2014) reported 515.3 to 256.6 seeds per umbel. Likewise, Mollah *et al*. (2015) reported 299.9 to 93.0 seeds per umbel in Bangladesh. The low mean number of seed per umbel may due to high temperature during flowering resulted in flower abortions and hence lower seed yield. So, selection of appropriate months in a given locality is crucial in onion seed production. Teshome *et al*. (2014) reported that, variation in number of seeds per umbel might be due to flower abortion caused by high temperature, lack of efficient pollinators of all the flowers in the umbel, shortage of nutrition which caused high competition and death of the weak florets in the umbel.

Seed Yield Per Umbel:

Seed yield per umbel was highly significantly differ ($p \leq 0.05$) on the two varieties. The maximum and minimum mean seed weights per umbel were recorded 3.38 g and 0.67 g, respectively from Nafid variety whereas the highest and lowest weights of seed per umbel were recorded 2.99 g and 1.25 g, respectively from variety Nafis.

Seed Yield Per Plant:

The average seed yield per plant ranged from 5.08 g to 15.18 g over variety Nafid while the maximum and minimum average number of seeds per plant of 7.80 g and 11.62 g over variety Nafis with an average of 9.08 g. Asaduzzaman et al. (2012) also described those larger-sized bulbs (20±1 g) and broader arrangement (25 × 20 cm) brings about in higher seed yield per plant (3.78 g). Bulb size and plant spacing are serious factors in generating quality onion seeds (Mirshekari and Mobasher, 2006).

Table 2: Mean performance of yield and yield related traits of two varieties over the study area

Variety	Location	NSP	SD	LMS	NUP	NFU	UD	NSU	SYU	SYP
Nafid	Amibara	4.20	1.12	55.20	6.60	280.40	2.58	180.80	1.49	8.45
	Fentale	4.00	1.20	57.60	6.80	291.20	2.46	178.20	1.66	8.04
	Mean	4.10	1.16	56.40	6.70	285.80	2.52	179.50	1.58	8.25
	SD	0.99	0.22	6.26	3.27	98.53	0.57	37.40	0.78	2.88
	SE	0.31	0.07	1.98	1.03	31.16	0.18	11.83	0.25	0.91
	Min	3.00	0.90	45.00	3.00	120.00	1.90	100.00	0.67	5.08
	Max	6.00	1.50	64.00	13.00	490.00	3.60	222.00	3.38	15.18
Nafis	Amibara	5.00	1.14	63.40	7.80	389.40	3.14	220.00	2.22	9.86
	Fentale	5.20	1.24	62.40	7.60	402.20	2.94	219.20	2.35	9.98
	Mean	5.10	1.19	62.90	7.70	395.80	3.04	219.60	2.29	9.92
	SD	0.88	0.19	5.86	2.11	53.97	0.51	34.82	0.70	1.11
	SE	0.28	0.06	1.85	0.67	17.07	0.16	11.01	0.22	0.35
	Min	4.00	1.00	56.00	5.00	296.00	2.50	182.00	1.25	7.80
	Max	6.00	1.60	71.00	11.00	475.00	4.20	280.00	2.99	11.62
Overall Mean		**4.60**	**1.18**	**59.65**	**7.20**	**340.80**	**2.78**	**199.55**	**1.93**	**9.08**
Diff (1-2) Mean		-1.00	-0.03	-6.50	-1.00	-110.00	-0.52	-40.10	-0.71	-1.68

N	10	10	10	10	10	10	10	10	10
DF	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	11.60
t-value	-2.39	-0.32	-2.40	-0.81	-3.10	-2.16	-2.48	-2.15	-1.72
Sig. (2 tail)	0.03	0.75	0.03	0.43	0.01	0.04	0.02	0.05	0.11
F-value	1.29	1.35	1.14	2.40	3.33	1.27	1.15	1.24	6.73
Sig.	0.71	0.66	0.85	0.21	0.09	0.73	0.84	0.76	0.01

SC=Stand Count at harvest, SNP= Number of Stalk plant-1, LMS= Length of main stalk (cm), NUP=Number of umbels plant^{-1}, NFU= Number of flowers umble^{-1}, UD= Umbel diameter (cm), NSU=Number of seed umple^{-1}, SYU= Seed yield umble^{-1}(gm), SYP= Seed yield plant^{-1}(gm), and SD= Stalk diameter (cm)

Training of Farmers and Das on Improved Production Packages

Training participants consisted of agro pastorals and developmental agents from two kebeles of each Amibara and Fentale districts. A total of 40 agro pastorals composed of booth females and males 4 developmental agents were participated in the training conducted on improved onion seed production packages (Figure 5 and 6).

The training was conducted at different time: prior to planting theoretical training were given on onion seed production and through all production periods (at planting, field management, harvesting and seed grading.

The report revealed that the training actually had an immense, positive impact on small scale agro-pastoralists the results indicated that of the agro-pastoralists at Fentale district that already had pragmatic knowledge of onion seed production showing their performance more than double that of Amibara district, this is reflecting an achievement of the training goal. The agro-pastoralists of both districts finally reflect on the following topics:

Time of Planting:

Timely planting is very much essential for onion seed production. Timely planted crop can achieve good vegetative growth and will get sufficient period for seed set before onset of high temperature, so the crop must be planted during September 1st.

Varieties:

Nafid and Nafis varieties are suitable for both districts in addition to Adama red and Bombe red varieties which are currently under production.

Weed Management:

In onion seed production hand weeding is better than any others. The agro-pastoralists were understood that weeding during bolting is not recommended so that destroys the bolting one.

Harvesting, Grading and Seed Treatment:

Farmers were exercised seed harvesting and grading techniques for the first time. It was done when the umbel/head exposes some black seeds but before shattering by hand. After harvest, the heads were dried on piece of clothes under open ventilated shed.

Carefully clip the stalks a few inches (8 cm.) below the head and place them in a sacs bag. Set the sac in a cool, dry place for a week to dry. When the heads were completely dry, it was shaken vigorously within the sac to release the seeds. The fine sieve was used to retain the seeds from

the dust to sort the seeds. Then the seeds were poured in cold water and stirred. The fertilized seeds were showed heavier than unfertilized seed, so they will sink. All empty ones and the debris that float was removed. Then immediately dry the good seeds on a plate.

In general, the attitude of agro pastoralists who engaged in onion seed production thinks it was difficult and complex work. Finally, there was a strong sense of appreciation articulated by the participants about being participated for the onion seed production training. Participants were very engaged and excited about what they learn about best all onion seed production practices, they highlighted that onion production is their lifeline as cash crop, they urged that future training be done often and should include more practical classes. Participants responded very positively throughout the training, and expressed a strong desire to enhance their skills in best onion seed production practices.

Fig.5: Pastorals and DA training at Amibara districts

Fig.6 Pastorals and DA training at Fentale districts

Field Performance of Onion Seed Production at Amibara and Fentale Districts

Productivity of any crop is a good indicator of the land conditions, since it directly reflects the difference in the quality and limitations of the land. The main objective of field management for farming is to generate favorable conditions for good crop growth, emergence, root growth, plant development, seed formation and harvesting period. Accordingly, the performance of the community-based onion seed productions was indicated in figure 5 and 6.

Land Preparation:

Land preparation is the first operation in ensuring that crops can achieve the best yields. Unfortunately, at the time of field preparation in the Fentale district the farmers were under the pressure of society leaders as they are ordered to produce only irrigated wheat. In addition, these practices are a burden for small-scale farmers that have to prepare seed beds manually with backward tools.

Crop Management:

Several crop managements determine a crop's field performance, including planting, irrigation and weeding. Adequate planting spacing is crucial for the development of the plant but in both locations the population of the onion decreased time to time due to bulb rotting and damage due to weeding managements.

Fig.3: Community based onion seed production at Amibara districts

Fig.4: Community based onion seed production at Fentale districts

CONCLUSION AND RECOMMENDATION

Conclusion

The finding showed significant differences between the two varieties in terms of yield and yield components: yield ha^{-1}, number of stalks per plant, length of main stalk, number of umbels per plant, number of flowers per umbel, umbel diameter, number of seeds per ample, seed yield per umbel, seed yield per plant, and stalk diameter. The result also indicates that there was a significant difference in the average seed yield of varieties Nafis (10.72 q ha^{-1}) and Nafid (9.17 q ha^{-1}) and that the Nafis variety really does have an advantage of 1.55 q ha^{-1} seed yield over the Nafid variety. Therefore, it can be concluded that the use of the improved onion variety for agro-pastoralists need to produce onion seed, the Nafis variety was recommended to increase their yields. Finally, the district administration; The head of the district agriculture office, experts and agro-pastoralist said that the experiences they have seen are viable and good, so they will work hard to spread it in other kebeles of both districts.

Recommendation

Community-based seed multiplication, as a modality important for technology delivery, provides all management practices for seed production and crop diversification; the introduction of newly improved and high-yielding varieties; opportunities for market integration; and experience sharing. Therefore, this type of community-based seed multiplication should be continued as it is

important to agro-pastoralists and farmers on transfer knowledge on onion seed production system.

The government of Ethiopia has been working to enhance wheat import substitution by intensifying domestic wheat production in various parts of the country. As the government teaches the summer wheat production, other crop production was neglected. Therefore, the district experts have to be accepted and informed the farmers about the small-scale onion and other crop production.

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REFERENCES

Nikus, O. and Fikre, M., 2010. Onion Seed Production Techniques: A Manual for extension agents and seed producers. Asella, Ethiopia: FAOCDMDP. pp. 1-86.

Lemma, D., Shimeles, A., Selamawit, K., and Chimdo, A., 2006. "The vegetable seed sector in Ethiopia: Current status and future prospects." In EHSS, Proceedings of the Inaugural and Third National Horticultural Workshop. pp. 103-109.

Tamrat, T., 2006. Effect of nitrogen and phospherous application on seed yield and nutrient uptake of onion (Allium cepa var. cepa). MSc. Thesis. Ethiopia: Haramaya Universty. pp. 1-81.

Getachew, A., 2014. Effect of plant spacing and NP fertilizer levels on growth, seed yield and seed quality of onion (Allium Cepa Var Cepa) in MSc. Thesis Shewa Robit, Northern Ethiopia, p. 66.

Aminpour, R. and Mortzavi, B. A., 2004. "Effect of planting date and intra-row spacing on seed yield and germination of onion (Allium cepa L. cv.Texas Early Grano 502." Pajouhesh and Sazandegi, vol. 62, pp. 64-69.

Shimeles, A., 2000. Study on flower and seed production potential and association of characters with seed yield in onion (Allium cepa L.). MSc thesis. Presented to the school of Graduate Studies of Alemaya University, p. 160.

Ahmed, I. H. and Abdella, A. A., 2006. "Nitrogen and phosphorus fertilization in relation to seed production in onion Allium cepa L." In ISHS. Acta Hortic; (143): VIII. African Symposium on Horticultural Crops.

SAS Institute, 2002. Statistical Analysis Software Package, SAS/STAT user's guide version 9. SAS Institute Inc., Cary NC, USA.

Lemma D. and S. Aklilu, 2003. Research Experiences in Onion production. Research Report No. 55. Ethiopia Agricultural Research Organization, Addis Ababa, Ethiopia.

Malik M.N., 2000. Horticulture Biotech Books. Delhi. 586p.

Hanelt P.,1990. "Taxonomy, Evolution, and History" In Onions and Allied Crops, edited by Haim D. Rabin witch and James L. Brewster, 1-26. Boca Raton, Fla. CRC Press

Augusti, K.T., 1990. Therapeutic and medicinal values of onions and garlic. In: Rabinowitch, H.D., Brewster, J.L. (Eds.), Onions and Allied Crops. CRC Press, CRC Press, Inc. Boca Raton, Florida, p. 93–108.

Desjardins, Y., 2008. Onion as a nutraceutical and functional food. Cronica Horticulturae, 48, 8–14.

Central Statistical Agency (CSA), 2018 The Federal Democratic Republic of Ethiopia Central Statistical Agency Agricultural Sample Survey. Report on Area and Production of Crops. Statistical Bulletin No. 586. Addis Abeba, Ethiopia.

Ashenafi Nigussie, Belstie Lulie and Midekesa Chala, 2015. Intercropping of Onion with Rosemary as Supplementary Income Generation at Wondo Genet Sidama zone, Southern Ethiopia. Acad. Res. J. Agri. Sci. Res. 5(2): 107-115

S. Ahmed, M.A. Rahim, M. Moniruzzaman , M.A. Khatun, F.N. Jahan and R. Akter, 2020. Effect of Bulb Sizes on the Seed Yield of Two Onions (Allium Cepa L.) Varieties. SAARC J. Agric., 18(2): 51-65

Tesfaye, M., Belew, D., Dessalegn, Y., & Shumye, G., 2018. Effect of planting time on growth, yield components, seed yield and quality of onion (Allium cepa L.) at Tehuledere district, northeastern Ethiopia. Agriculture & Food Security,7(1),28. https://doi.org/ 10.1186/ s40066-018-0178-0

Khokhar, K. M.; Kaska, N.; Hussain, S. I.; Qureshi, K. M.; Mahmood, T., 1990. Effect of different sowing dates, direct seeding and transplanting of seedling on maturation, bulb weight and yield in onion (Allium cepa) cultivars. Indian Journal of Agricultural Science 1990 Vol.60 No.10 pp.

Asaduzzaman MD, Mahmudul Hasan MD, Mainul Hasan MD, Moniruzzaman MD, 2012. Quality seed production of onion (Allium cepa L.): An integrated approach of bulb size and plant spacing. Bangl. J. Agric. Res. 50(1):119-128.

Pushpendra Singh, AK Soni, Pratishtha Diwaker, Atma Ram Meena and Deepika Sharma, 2017. Genetic Variability Assessment in Onion (Allium cepa L.) Genotypes. IJCS 2017; 5(5): 145-149

Geetharani P, Ponnuswamy AS, 2007. Seed yield in relation to bulb size and umbel number in onion (Allium cepa L. cv. Aggregatum). Int. J. Plant Sci. 2(1):12-15.

Ashrafuzzaman M, Millat MN, Ismail MR, Uddin MK, Shahidullah SM, Meon S, 2009. Paclobutrazol and bulb size effect on onion seed production. Int. J. Agric. Biol. 11(3):245-250.

Pandey UB, Panwar DS, Sharma VP, 1994. Effect of spacing and levels of nitrogen on growth and seed yield of kharif onion. S. Res. 20(2):147-148.

Mollah MKU, Quadir MA, Ali M, 1997. Effect of bulb size on seed production of two onion cultivars. Bangl. J. Hortic. 15(1):18-23.

Teshome, A., Derbew, B., Sentayehu, A., and Yehenew, G., 2014. "Effects of Planting Time and Mother Bulb Size on Onion (Allium cepa L.) Seed Yield and Quality at Kobo Woreda, Northern Ethiopia." International Journal of Agricultural Research, vol. 9, pp. 1-11.

Asaduzzaman, M.D., M.D. Mahmudul Hasan, M.D. Mainul Hasan, M.D. Moniruzzaman, 2012. Quality Seed Production of Onion (Allium Cepa L.): An Integrated Approach of Bulb Size and Plant Spacing. Journal of Agricultural Research. 50(1):119-128.

Mirshekari B, Mobasher M, 2006. Effect of sowing date, plant density and onion size on seed yield of Azashahr Red onion variety in Tabriz. J. Agric. Sci. Isla Azad Univ. Pa