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THE EFFECTS OF FLOWER REMOVAL AND EARTHING UP ON TUBER YIELD AND QUALITY OF POTATO (*SOLANUM TUBEROSUM* L.)

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Abstract: A field experiment was conducted in Eastern Tigray, Ethiopia, during the summer season to determine the effects of flower removal and earthing up time on the tuber yield and quality of potato (*Solanum tuberosum* L.). The experiment comprised three flower removal stages and five earthing up time treatments, which were laid out in a randomized complete block design (RCBD) of a 5x3 factorial arrangement with three replications. Data collected on tuber yield and quality parameters were analyzed using SAS version 9.2. The interaction of flower removal stages and earthing up time treatments affected marketable and unmarketable tuber number and yield, total tuber number and yield, large-sized tuber weight, and number of large-sized tubers. The medium and small-sized tubers were also affected by main treatments but not by their interaction treatments. Similarly, dry matter content was significantly ($p<0.05$) affected by flower removal alone, but not by earthing up time and its interaction with flower removal. Generally, the highest marketable tuber yield (30.25 t ha^{-1}), large-sized tuber weight (424.9 g), the number of large-sized tubers (5), and total tuber yield (30.96 t ha^{-1}) were recorded in the treatment of potato flower removed at the bud stage and earthed up at 15 days after complete emergence. Therefore, the removal of potato flowers at the bud stage and earthing up at 15 days after complete emergence and common cultivation can be practiced for better tuber yield and quality of potato.

Key words: dry matter content, earthing up, flower removal, tuber yield, tuber quality.

Introduction

Potato (*Solanum tuberosum* L.) is one of the most important food crops in the world. China is the biggest producer of potatoes worldwide, with about one-third of the world's potatoes produced in China and India. According to FAOSTAT (2019),

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over 370 million metric tons of potatoes were produced worldwide. Potatoes are an essential crop and are recommended as a food security crop by the United Nations. Potatoes can grow in different climate conditions. They take less time to grow and need less input than other vegetables, and they can be replanted as seed potatoes. Potatoes provide high food energy and complex carbohydrates while taking up a smaller unit of land than other alternatives. Potato has been identified as a cheap source of the human diet since it produces more food value per unit time in terms of the supply of carbohydrates, quality protein (lysine), minerals, nutrient salts and several B-group vitamins and a large amount of vitamin C (Horton, 1987). Due to these merits, potato ranks first in the expansion of production in developing countries.

Ethiopia is endowed with suitable climatic and edaphic conditions for quality potato production. About 70% of the available agricultural land is located at an altitude of 1800–2500 m a.s.l and receives an annual rainfall of more than 600 mm, which is suitable for potato production (Solomon, 1987). According to FAOSTAT (2016), the area under potato cultivation was about 51,698 ha in 2005/2006 producing 509,716 tonnes of tuber yields; in 2014/2015, the area under potato crop increased to 67,362 ha, and its productivity was about 921,832 tonnes. Its national productivity was 13.7 tonnes per hectare in the production years of 2014/2015 (FAOSTAT, 2016), which is still far less than that of other countries such as New Zealand (50.2 t ha^{-1}) and North America (41.2 t ha^{-1}). The main contributing factors for underproduction and underutilization of potato are lack of high yielding and disease-tolerant varieties, unavailability of quality seed and poor agriculture practices. However, the production could be increased by applying better agronomic practices or management, such as earthing up at the appropriate time and removing flowers at the proper stage, which contributed to a substantial amount of crop yield.

Proper earthing up increases tuber yield by creating favourable conditions for tuber initiation and development and prevents the greening of tubers. Poor ridging around a potato plant could expose the tuber to sunlight, high temperatures, diseases, and insect damage, which could affect the yield and quality of the tuber (Gebremedhin et al., 2008). In addition, the removal of potato flower has a great impact on tuber yield and quality. Flowers and tubers would compete to acquire assimilates and pruning of flowers or berries would increase transferred assimilates into underground structures and increase tuber yield (Almekinders and Struik, 1996). Hence, there is an attempt to increase tuber yield and quality of potato by promoting improved techniques and applying proper agronomic practices in the production areas. Flowers are less valuable economically in potato production. However, in Eastern Tigray, Ethiopia, many farmers who grow potatoes frequently do not consider earthing up and flower removal. This results in low and erratic tuber yield and quality. Thus, potato tuber production with appropriate time of

earthing up and flower removal for maximum yield and better quality is not well known. Therefore, the objective of this study was to determine the effects of flower removal and earthing up on the tuber yield and quality of potato (*Solanum tuberosum* L.) in Eastern Tigray, Ethiopia.

Materials and Methods

Description of the study area

The field experiment was conducted in Maymegelta, Eastern Tigray, Ethiopia, for the 2018 summer season. The site is located at an altitude of 2492 m above sea level and lies at 14^0 15` to $14^0$ 30` N latitude and 39^0 30` to $39^0$ to 45` E longitude. The mean annual rainfall is 475 mm, which ranges from 350 to 600 mm. The texture of the topsoil of the study area is sandy loam with organic matter of 0.45% and pH of 6.15.

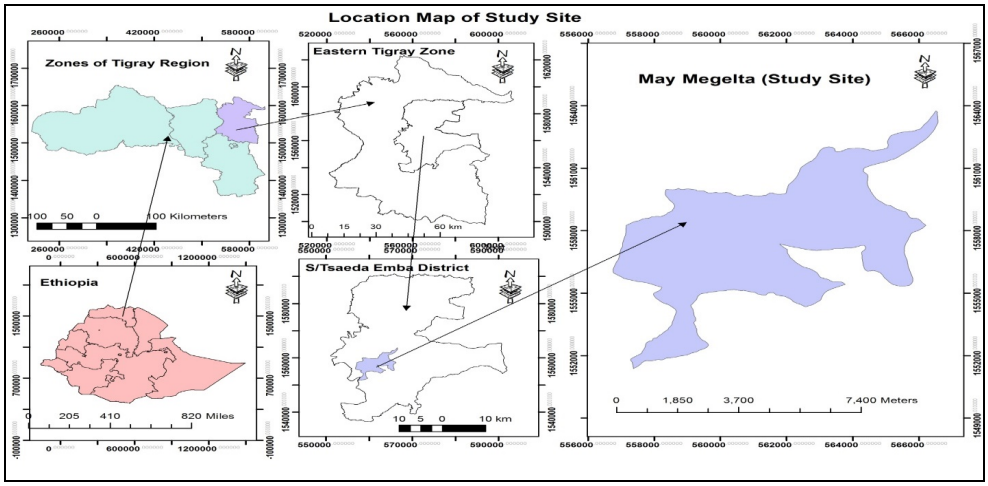


Figure 1. The map of the study area of Maymegelta, Saesie Tsaeda Emba, Eastern Tigray.

Experimental treatments and design

To study the effect of flower removal and earthing up time on tuber yield and quality of potato, a 5x3 factorial experiment based on a randomized complete block design with three replications was conducted. The first factor was three flower removal stage treatments: normal growth potato (growth of potato was not disturbed, allowed to flower, and set fruit (control)), flower removal at the bud

stage (potato was not allowed to produce flowers and all flower clusters were nipped off at the bud stage before opening); and flower removal after full opening (flowers were removed when fully opened). The second factor was five earthing up time treatments including control (no earthing up), earthing up at 15 days, 30 days, 45 days, and 60 days. The treatments of earthing up were applied after complete emergence, and common cultivation was applied for all treatments equally. The size of the unit plot was 3x2.4 m, and each included four rows. The well-sprouted local seed tubers of potato were planted at a depth of 12 cm, and plants were spaced 30cm apart in each plot. The row distances in plots, the path between plots within each block and distance between blocks were 75 cm, 50 cm, and 1 m, respectively.

Experimental procedures

The experimental site was plowed, and the ridge prepared well as per the recommended practices. Potato tubers of the promising local variety named Shashemene were prepared and separated. Hand weeding, side dressing and other agronomic practices were applied uniformly to all treatments. Phosphorus was applied in the form of DAP at the planting time at a rate of 195 kg ha^{-1} and nitrogen in the form of urea was applied in a split dose, at planting and after full emergence at a rate of 165 kg ha^{-1} (EARO, 2004). Initial light irrigation was applied five days after planting. Subsequent irrigation was given at a seven-day interval depending upon the climatic conditions and soil type. For the earthing up treatments, before applying treatments, the first cultivation was applied for all treatments, then the soil was uniformly put around the plant up to 20 cm high at the different times according to earthing up treatments except control. Other agronomic practices and pest management were applied uniformly for all treatments based on the national recommendation (EARO, 2004).

Data collected

Marketable tuber number per hill was counted as a marketable tuber based on its size category, greater or equal to 25g, and free from disease (Lung'aho et al., 2007). Unmarketable tuber number per hill was counted as an unmarketable tuber based on its size category, < 25g, including disease and insect attacks (Lung'aho et al., 2007). Total tuber number was determined as the sum of marketable tuber number and unmarketable tuber number per hill. Marketable tuber yield (tha^{-1}) was free from diseases, and greater than or equal to 25 g (Lung'aho et al., 2007).

Unmarketable tuber yield (tha^{-1}) was determined by weighing diseased, and small-sized (< 25g) tubers from the net plot area. Total tuber yield (tha^{-1}) was determined as the sum of the weights of marketable and unmarketable tubers from

the net plot area and was calculated based on ton per hectare. Tuber size distribution in weight (g) was recorded by weighing the number of tubers that were categorized into small (<39 g), medium (39 –75 g) and large (>75 g), according to Lung'aho et al. (2007). Tuber size distribution was recorded by counting the number of tubers that were categorized into small (<39 g), medium (39–75 g) and large (>75 g) according to Lung'aho et al. (2007). Tuber dry matter content (%) was determined randomly by selecting five potato tubers from each plot, chopping them into small 1–2 cm cubes, mixing them thoroughly, and two fresh sub-samples of 200 g were prepared. Each sub-sample was placed in a paper bag and put in an oven at 70^{o}C until a constant dry weight was attained. Each sub-sample was immediately weighed, and the mean recorded as dry weight. Percent dry matter content for each subsample was calculated based on the following formula:

$$\text{Tuber dry matter content (\%)} = \frac{\text{Tuber dry weight (g)}}{\text{Tuber fresh weight (g)}} \text{X } 100 \quad (1)$$

Methods of data analysis

All the relevant data collected from the experimental plots was subjected to analysis of variances (ANOVA) and computed using SAS computer software program version 9.2. Significant treatment means were compared using the least significant difference (LSD) test at $p< 0.05$ probability level.

Results and Discussion

Marketable tuber number

Marketable tuber number was significantly affected ($p<0.05$) by the interaction of flower removal and time of earthing up treatments. As shown in Table 1, the highest number of marketable tuber (11.56) was recorded in the potato flower removed at the bud stage and earthed up at 30 days after full emergence. However, there was no significant difference in the treatments of the potato flower removed at the bud stage and earthed up at 15 days (11.5), the potato flower removed at the full opened stage and earthed up of at 15 days (11.5), and potato without removed flower and earthed up at 15 days after complete emergence (11.49). On the contrary, the lowest marketable tuber number (6.83) was found in the potato without flower removal and earthing up (Table 1). It is believed that preventing the growth of reproductive organs could avoid competition for assimilates. Thus, most of the tubers in which flowers were removed at the bud stage attained marketable tuber size, and the number of marketable tubers increased accordingly. However, there is no evidence showing the interaction effect between flower removal and earthing up on marketable tuber numbers. Tekaligen (2005)

reported that the highest marketable tuber number was obtained from potato plants when their flowers were removed at the bud stage before opening, followed by potato whose flowers were removed after being fully opened compared to the normal potato plant.

Unmarketable tuber number

The analysis of variance indicated that unmarketable tuber number was significantly ($p < 0.05$) affected by their interaction (Table 1). The highest unmarketable tuber number (1.33) was found in the potato treatment without removing flowers and earthing up, while there was no significant difference in potatoes when flowers were removed at the full opening stage without earthing up (1.32); and potato without removed flowers and earthed up at 60 days after complete emergence (1.21). On the other hand, the lowest unmarketable tuber number (0.69) was found in potato without removed flowers and earthed up at 15 days after full emergence. However, there was no significant difference in the result obtained from potato without removed flowers and earthed up at 30 days after full emergence (0.79); and potato with flowers removed at the full opening stage and earthed up at 15 days after full emergence (0.79) (Table 1).

Total tuber number

A significant difference ($p < 0.05$) in the total tuber number was obtained due to interaction and the main effect of flower removal and time of earthing up (Table 1). The highest total tuber number (12.4) was recorded in potato flowers removed at the bud stage and earthed up at 30 days after full emergence. Hence, there was no significant difference in the result found in potato with flowers removed at the bud stage and earthed up at 15 days after full emergence (12.3); and the treatment of potato with flowers removed at the full opening stage and earthed up at 15 days after full emergence (12.29). On the contrary, the lowest total tuber number was also observed in potato without removed flower and earthing up (8.16). However, there was no significant difference in the result found in potato without removed flower and earthed up at 60 days after full emergence (9.31) as well as in the treatment of potato with flowers removed at the full opening stage and earthing up at 60 days (9.42) (Table 1). This may be because when potato flowers are removed at the right stage and earthing up at the right time, it increases the number of tubers. A similar work was reported by Bizuayehu and Tekaligen (2008) that the existence of flower buds decreased productivity by reducing the tuber number. This could be due to high gibberellic acid activity, which leads to reduced partitioning of assimilates to tubers while encouraging stolon elongation and reducing the tuber number.

Table 1. The interaction effect of flower removal and earthing up on marketable tuber number (MTN), unmarketable tuber number (UmTN) and total tuber number (TTN) of potato grown in Eastern Tigray, Ethiopia.

Treatments		Parameters		
Flower removal stage	Earthing up time	MTN	UmTN	TTN
Normal growth/ Without flower removal	Control	6.83f	1.33a	8.16f
	at 15 days	11.49a	0.69f	12.19abc
	at 30 days	11abc	0.79ef	11.79abcd
	at 45 days	10.5abcd	0.93bcd	11.43abcd
	at 60 days	8.1ef	1.21a	9.31f
Flower removal at the bud stage	Control	10.55abcd	1.01b	11.57abcd
	at 15 days	11.5a	0.78def	12.3ab
	at 30 days	11.56a	0.83cde	12.4a
	at 45 days	11.16abc	0.92bced	12.09abc
	at 60 days	9.93cd	0.97bc	10.9cd
Flower removal after the full opening stage	Control	9.33de	1.32a	10.66de
	at 15 days	11.5a	0.79ef	12.29ab
	at 30 days	11.41ab	0.81def	12.22abc
	at 45 days	10.16bcd	0.86cde	11.03bcd
	at 60 days	8.41e	1.0b	9.42ef
LSD (0.05)		1.29	0.13	1.34
Level of significance		*	*	*
CV (%)		7.73	8.29	7.37

Values followed by the same letter/s are not significantly different at 0.05% probability level.

Marketable tuber yield

Marketable tuber yield of potato was significantly affected ($p < 0.05$) by the interaction of flower removal and time of earthing up treatments. The highest marketable tuber yield (30.25 t ha^{-1}) was recorded in the potato treatment with flowers removed at the bud stage and earthing up at 15 days after full emergence. However, there was no significant difference in the potato treatment with flowers removed at the bud stage and earthing up at 30 days after full emergence (30.1 t ha ^{1}). On the other hand, the lowest marketable tuber yield (8.63 tha^{-1}) was found in the potato treatment without removing flowers and earthing up, but there was no significant difference in the potato treatment without removing flowers and earthing up at 60 days after full emergence (Figure 2). The result of the highest marketable tuber yield achieved because of flower removal may be due to the absence of competition for a limiting factor between developing flowers and tubers. It was also speculated that in the absence of reproductive parts, presumably since developing tubers were the pre-dominant sinks, many assimilates were diverted to the tubers, which would otherwise be utilized for flower and fruit

production (Tekaligan, 2005). As a result, most of the initiated tubers in this study increased in size and attained marketable size in agreement with the findings of Bartholdi (1940).

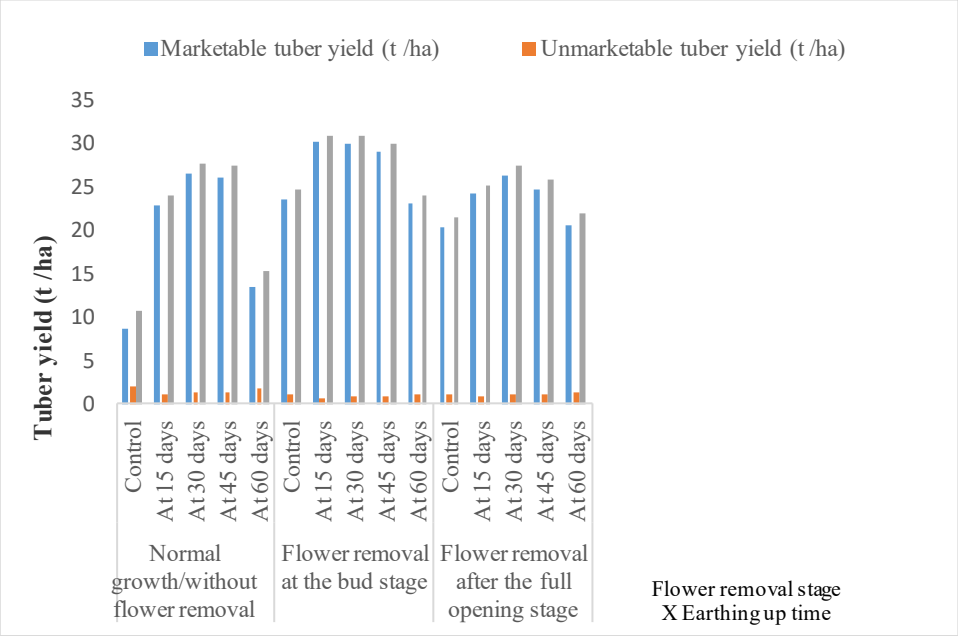


Figure 2. The interaction effect of flower removal and earthing up time on the marketable tuber yield, unmarketable tuber yield and total tuber yield of potato grown in Eastern Tigray, Ethiopia.

Unmarketable tuber yield

The analysis of variance indicated that the unmarketable tuber yield was significantly ($p < 0.05$) affected by interaction effects of flower removal and earthing up time treatments. The highest unmarketable tuber yield (2.1t ha^{-1}) was found in potato without removed flowers and earthing up, while there was no significant difference in the treatment of potato without removing flower and earthing up at 60 days after full emergence (1.83t ha^{-1}). However, the lowest unmarketable tuber yield (0.71t ha^{-1}) was found in the treatment of potato with flowers removed at the bud stage and earthing up at 15 days after full emergence. There was no statically significant difference in the treatment of potato with flowers removed at the bud stage and earthing up at 30 days after full emergence (0.83t ha^{-1}) (Figure 2). Moreover, a higher number of tubers affected by disease,

malformed and pre-harvest sprouting on tubers were observed in potato without removed flower and earthing up. This result agreed with Tafi et al. (2010), who reported that soil added to the plant affected the potato product structure. This is due to the appropriate time of the soil addition for active physiological growth stages that create favorable soil environment for tuber yield.

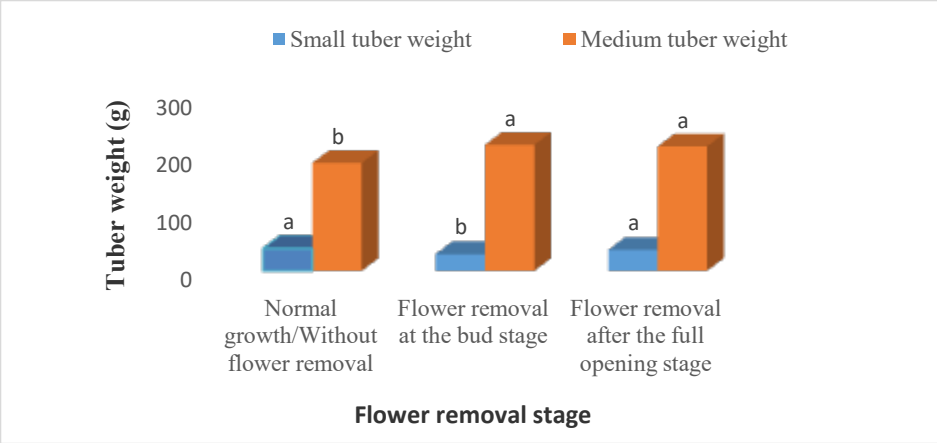
Total tuber yield

The analysis indicates that total tuber yield was significantly ($p<0.05$) influenced by the interaction effect of flower removal and earthing up time. Figure 2 indicates that the highest total tuber yield (30.96 t ha^{-1}) was recorded in the potato treatment with flowers removed at the bud stage and earthing up at 15 days after complete emergence. However, there was no significant difference in the result obtained from the treatment of potato with flowers removed at the bud stage and earthing up at 30 days after full emergence (30.93t ha^{-1}). On the contrary, the lowest total tuber yield (10.74 t ha^{-1}) was obtained from the potato treatment without removing flowers and earthing up. However, no significant difference was found in the potato treatment without removing flower and earthing up at 60 days after full emergence (15.37 t ha^{-1}) (Figure 2). This seems to indicate that flower and fruit development had a depressing effect on tuber development, which may be due to active competition for assimilating among flowers and fruits and developing tubers (Tekalign, 2005). Ali (2016) also reported that potato florescence removal increased tuber yield by 13% compared to the treatment without florescence removal. Similarly, Nazari (2010) and Tekalign (2005) also reported that tuber yield would be increased by 9 and 18 percent when the florescence of potato was removed compared to unremoved flowers. The result is also in agreement with research done by Hassen et al. (2013) on anchote accessions, when the flower bud removal treatment increased root yield by 15.87%. This is due to the intense competition that exists between the reproductive and root parts.

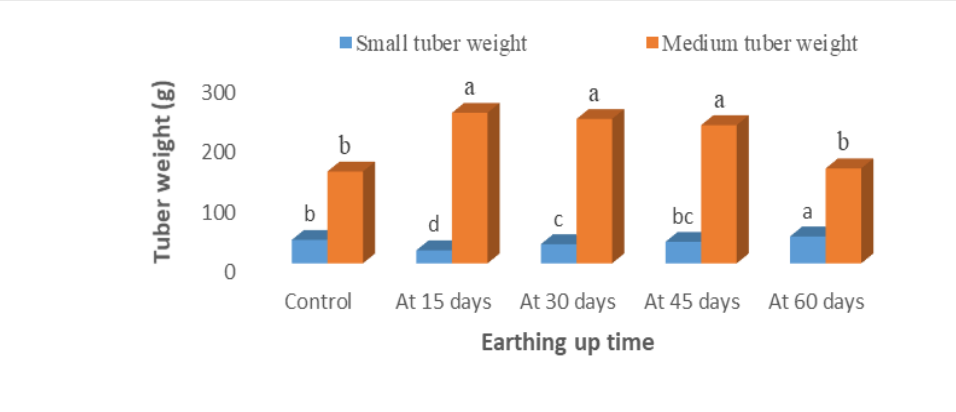
Potato tuber size distribution in weight

A. Small-sized tuber weight (<39 g): The result has shown that small-sized tuber weight was significantly ($p<0.05$) affected by flower removal and the time of earthing up treatments, but it was not significantly ($p>0.05$) affected by their interaction effects. As indicated in Figure 3, the largest small-sized tuber weight (38.67g) was obtained from the treatment of potato without removing flowers, but there was no significant difference in the treatment of potato with flowers removed at the full opening stage (36.24g). In contrast, the smallest weight of small-sized tubers (29.06 g) was recorded in the treatment of potato with flowers removed at the bud stage. In the case of earthing up, the largest small-sized tuber weight was

found in potato earthed up at 60 days after full emergence (44.83 g), whereas the smallest weight of small-sized tubers was also recorded in potato earthed up at 15 days after full emergence (21.71g) (Figure 3).



(a)



(b)

Figure 3. The effects of flower removal (a) and earthing up time (b) on small-sized tubers (<39 g) and medium-sized tubers in weight (39–75 g) of potato grown in Eastern Tigray, Ethiopia.

Medium-sized tuber weight (39–75 g): The analysis of variance results has shown that medium-sized tuber weight was significantly ($p < 0.05$) influenced by the main effect of flower removal and earthing up time. The largest medium-sized tuber weight was recorded in the treatment of potato with flowers removed at the

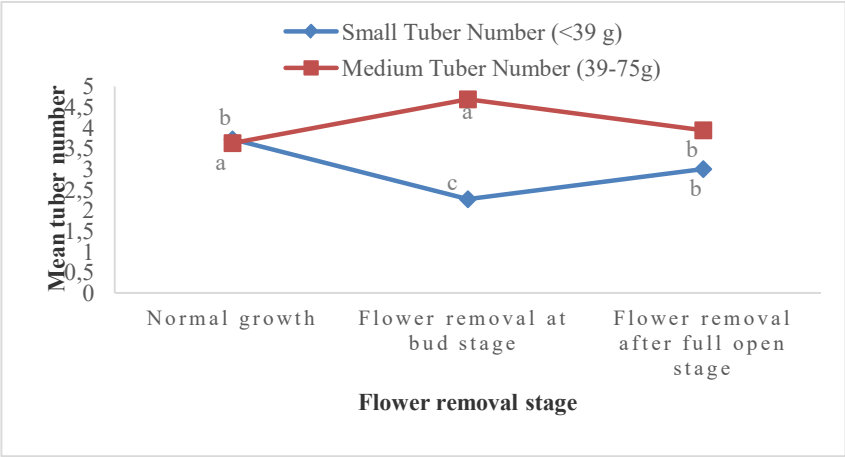
bud stage (217.71g), but non-significant difference was observed in the treatment of potato with flowers removed at the full opening stage (214.94 g). On the contrary, the smallest medium-sized tuber weight was found in the treatment of potato without removing flowers (186.47 g). The result of earthing up has also shown that the largest medium-sized tuber weight (250.59 g) was recorded in the treatment of potato earthed up at 15 days after complete emergence. However, there was no significant difference in the treatment of potato earthed up at 30 days (240.33 g) and 45 days after full emergence (230.03 g). On the other hand, the smallest medium-sized tuber weight (152.89 g) was recorded in control (without earthing up), but there was no significant difference in the treatment of potato earthed up at 60 days after full emergence (158.03 g) (Figure 3). Earthing up at 15 days after complete emergence might create favorable conditions for producing a good yield of medium-sized tubers of potato. This result is supported by the report of Qadir et al. (1999), who confirmed that earthing up at 15 days after complete plant emergence resulted in better yield performance.

Large-sized tuber weight (>75 g): The analysis of variance revealed that interaction effects of flower removal and earthing up time significantly ($p<0.05$) influenced large-sized tuber weight. As indicated in Table 2, the highest large-sized tuber weight (424.9 g) was obtained from the treatment of potato with flowers removed at the bud stage and earthing up at 15 days after full emergence. However, there was no significant difference in the treatment of potato with flowers removed at the bud stage and earthing up at 30 days (412.5 g); and at 45 days after full emergence (409.32 g). Hence, the lowest large-sized tuber weight (113.79 g) was obtained from the potato treatment without removing flowers and earthing up, but there was no significant difference in the result found in the potato treatment without removing flowers and earthing up at 60 days after full emergence (171.43 g) (Table 2). This could be early earthing up during the active growth period of the plant that improved the soil conditions for nutrient absorption; plants absorbed the sufficiently available resources and increased their photosynthetic efficiency that ultimately increased the number of large-sized tubers. The result supported the observations of Qadir et al. (1999) that earthing up at 15 days after complete plant emergence resulted in better yield.

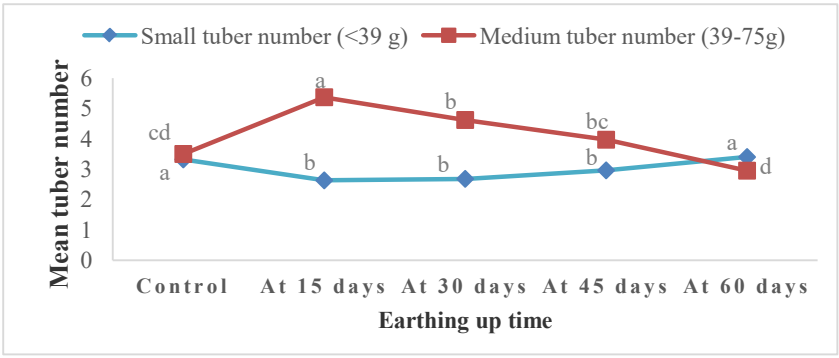
Number of tuber size distribution

A number of small-sized tubers (<39 g): The main factors of flower removal and earthing up time significantly ($p<0.05$) affected the number of small-sized tubers. As indicated in Figure 4, the highest small-sized tuber number (3.72) was obtained from the treatment of potato without removing flowers, whereas the lowest small-sized tuber number (2.27) was recorded in the treatment of potato with flower removed at the bud stage. In the case of earthing up, the highest

number of small-sized tubers (3.4) were found in potato earthed up at 60 days after full emergence, but there was no significant difference in potato non-earthing up (3.32). On the contrary, the lowest small-sized tuber number (2.63) was recorded in the treatment of potato earthed up at 15 days after full emergence. However, there was no significant difference among treatments of potato earthed up at 30 days (2.68) and at 45 days after full emergence (2.96) (Figure 4).



(a)



(b)

Figure 4. The effects of flower removal (a) and earthing up time (b) on small-sized tuber number (<39 g) and medium-sized tuber number (39–75g) of potato grown in Eastern Tigray, Ethiopia.

B. The number of medium-sized tubers (39–75 g): Flower removal and earthing up time significantly ($p<0.05$) influenced the number of medium-sized

tubers, but the two factors did not interact to influence the number of medium-sized tubers. As indicated in Figure 4, the highest number of medium-sized tubers was obtained from the treatment of potato with flowers removed at the bud stage (4.69), whereas the lowest number of medium-sized tubers (3.63) was found in the potato treatment without removing flowers. In the case of earthing up, the highest number of medium-sized tubers (5.37) was recorded in the treatment of potato earthed up at 15 days after full emergence. On the other hand, the lowest number of medium-sized tubers was found in the treatment of potato earthed up at 60 days after full emergence (2.95), but there was no significant difference in potato non-earthed up (3.5) (Figure 4). This might be earthing up at 15 days after complete plant emergence that created favorable conditions for plant growth and ultimately a greater number of medium-sized tubers produced. This result is in line with the findings of Qadir et al. (1999), who confirmed that earthing up at 15 days after complete plant emergence resulted in better yield performance.

C. The number of large-sized tubers (>75g): The analysis of variance indicated that interaction effects of flower removal and earthing up time significantly ($p< 0.05$) affected the number of large-sized tubers (Table 2).

Table 2. The interaction effect of flower removal and earthing up on the weight of large-sized tubers (>75g) and the number of large-sized tubers (>75g) of potato grown in Eastern Tigray, Ethiopia.

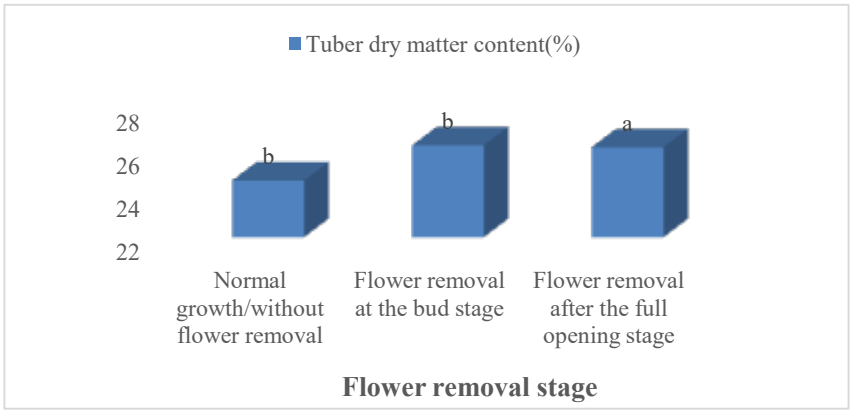
Treatments		Parameters	
Flower removal stage	Earthing up time	Weight of large-sized tubers (>75g)	Number of large-sized tubers (>75g)
Normal growth/ without flower removal	Control	113.79e	1.63g
	At 15 days	257.83d	3.39e
	At 30 days	324.78cd	4.27cd
	At 45 days	325.42cd	4.28bcd
	At 60 days	171.43e	2.5f
Flower removal at the bud stage	Control	357.18abc	4.32bcd
	At 15 days	424.9a	5.38a
	At 30 days	412.5ab	5.32a
	At 45 days	409.32ab	5.09ab
	At 60 days	340.17bc	4.34bcd
Flower removal after the full opening stage	Control	298.58cd	3.97de
	At 15 days	323.03cd	4.25cd
	At 30 days	370.92abc	4.88abc
	At 45 days	342.17bc	4.06de
	At 60 days	296.24cd	3.74de
LSD (0.05)		76.41	0.82
Level of significance		*	*
CV (%)		13.72	10.88

Values followed by the same letter/s are not significantly different at 0.05% probability level.

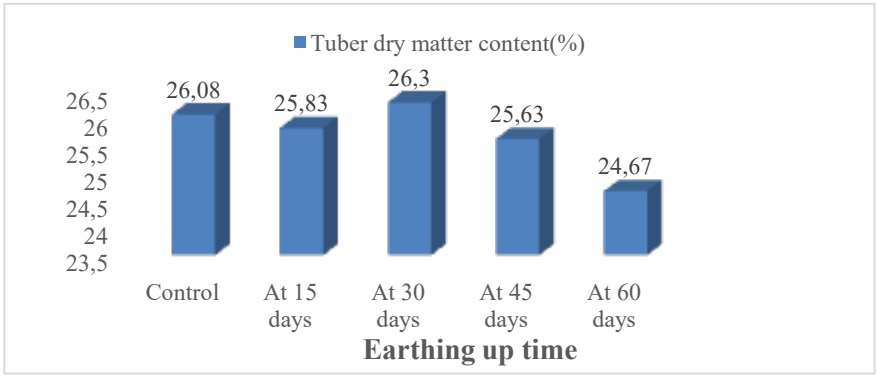
The highest number of tubers (5.38) was found in the treatment of potato with flowers removed at the bud stage and earthing up at 15 days after full emergence. However, there was no significant difference in the treatment of potato with flowers removed at the bud stage and earthing up at 30 days after full emergence (5.32). On the contrary, the lowest number of large-sized tubers was recorded in the potato treatment without removing flowers and earthing up (1.63). The treatment of potato with flowers removed after the full opening and earthing up at 60 days after full emergence (3.74); and the treatment of potato with flowers removed after the full opening without earthing up (3.97) showed non-significant results (Table 2). This could be due to early earthing up during the active growth period of the plant that improved the soil conditions for nutrient absorption; plants absorbed the sufficiently available resources and increased their photosynthetic efficiency that ultimately increased the number of large-sized tubers. The result agreed with the research finding of Almekinders and Struik (1996). The authors have reported that flowers and tubers of potato compete to attract assimilates and pruning of flowers would increase assimilate transition to underground structures to increase the yield of the tuber. The result also supported the observations of Qadir et al. (1999) that earthing up at 15 days after complete plant emergence resulted in a better yield of large-sized tubers.

Dry matter content

The analysis of variance indicated that the main factor of flower removal significantly ($p<0.05$) affected the dry matter content of the potato tuber. However, earthing up time and their interaction had no influence. As indicated in Figure 5, the highest dry matter content was recorded in the treatment of potato with flowers removed at the bud stage (26.27). However, there was no significant difference in the result recorded in the treatment of potato with flowers removed after the full opening (24.64). On the contrary, the lowest dry matter content was found in the potato treatment without removing flowers (26.19) (Figure 5). The increase in values of the dry matter content of tubers may be due to the largest proportion of assimilates being diverted to the developing tubers rather than to flower production. Consequently, more carbohydrate could be accumulated in the tubers as dry matter. The result supported the observations of Tekaligen (2005), who reported that removing flowers significantly increased the tuber dry matter content of potato. Hassen et al. (2013) also reported that an increase in dry matter content because of flower bud removal in different anchote accessions might be due to the flow of an ample amount of assimilates to the sink, which would have otherwise contributed to fruit development, ultimately resulting in high dry matter content in roots. In the case of earthing up, the highest value of the dry matter content of tubers was recorded in the treatment of potato earthing up after 30 days (26.3). However, it was a non-significant difference among all the treatments of earthing up.



(a)



(b)

Figure 5. The effects of flower removal (a) and earthing up time (b) on the dry matter content of the potato grown in Eastern Tigray, Ethiopia.

Conclusion

The investigation revealed that the highest marketable tuber yield (30.25 t ha^{-1}), weight of large-sized tubers (424.9 g), number of large-sized tubers (5.38) and total tuber yield (30.96 t ha^{-1}) were recorded in the potato treatment with flowers removed at the bud stage and earthing up at 15 days after complete emergence. However, there was no significant difference in the result obtained from the treatment of potato with flowers removed at the bud stage and earthing up at 30 days after full emergence. Therefore, removing potato flowers at the bud stage and earthing up at 15 days after complete emergence can be practiced for better tuber yield and quality of potato.

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UTICAJ UKLANJANJA CVETOVA I ZAGRTANJA NA PRINOS KRTOLA I KVALITET KROMPIRA (*SOLANUM TUBEROSUM* L.)

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R e z i m e

Poljski ogled je sproveden u istočnom Tigraju (Etiopija), tokom letnje sezone kako bi se utvrdili uticaji uklanjanja cvetova i zagrtanja na prinos krtola i kvalitet krompira (*Solanum tuberosum* L.). Ogled je obuhvatao tri faze uklanjanja cvetova i pet tretmana zagrtanja, koji su postavljeni u potpuno slučajnom blok sistemu faktorskog rasporeda 5x3 sa tri ponavljanja. Podaci prikupljeni o prinosima i parametrima kvaliteta krtola analizirani su korišćenjem verzije SAS 9.2. Interakcija uklanjanja cvetova i zagrtanja uticala je na broj tržišnih i netržišnih krtola i prinos krtola, ukupan broj i prinos krtola, masu velikih krtola i broj velikih krtola. Na krtole srednje i male veličine uticali su glavni tretmani, ali ne i njihove interakcije. Slično tome, na sadržaj suve materije značajno je uticalo ($p<0,05$) samo uklanjanje cvetova, ali ne i vreme zagrtanja i njegova interakcija sa uklanjanjem cvetova. Generalno, najveći prinos tržišnih krtola (30,25t ha^{-1}), masa velikih krtola (424,9 g), broj velikih krtola (5), i ukupni prinos krtola (30,96t ha^{-1}) zabeleženi su u tretmanu krompira sa uklanjanjem cvetova krompira u fazi pupoljka i zagrtanjem 15 dana posle potpunog nicanja. Stoga se uklanjanje cvetova u fazi pupoljka i zagrtanje 15 dana posle potpunog nicanja i uobičajena kultivacija mogu primeniti radi boljeg prinosa i kvaliteta krtola krompira.

Ključne reči: sadržaj suve materije, zagrtanje, uklanjanje cvetova, prinos krtola, kvalitet krtola.

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