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Research paper

Studies on weed species, effect of cultural and chemical weed control methods on the growth performances of *Allium cepa*

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***Allium cepa* (Onions) is one of the major vegetables that is consumed all over the world after tomatoes due to is active compounds but weeds infestation during growth phase are the major challenge faced by the farmers which result in a very poor growth and yield of this spice. In this study, the conventional hand weeding practices were compared with weedicide pendimethalin to control different weeds and the morphological characters such as; number, size, height, neck area and fresh weight of the onions bulbs planted at Department of Plant Science and Biotechnology, Botanical Garden, KSUSTA. Twelve (12) weeds of different family were found and identified from the experimental field namely; *Urena lobata, Eragrostis tremula, Amaranthus viridis, Senna occidentalis, Cenchruse chintus, Mitracarpus scaber, Commelina lanata, Zornia latifolia, Cassia tora, Sida cordifolia, Cleome viscosa* and *Euphorbia thyamifolia*. In all, the treatments used cultural, chemical and integrated methods had shown a positive significant effect on weed control and yield of onion. This study revealed that cultural control (hand weeding) is the best method of weed, control as it provides maximum weed control in the tested vegetable as well as higher yield.**

Key words: *Allium cepa, weeds, treatments, hand weeding*

INTRODUCTION

Allium cepa is a biennial evergreen, herbaceous plant belonging to the family of Alliaceae that are known as "Albasa" by Hausa speaking and onion in English. It produces bulb with orbit shape below the ground, leaves and white greenish, flower typically above the ground that can be seen during seed production. Onion is one of the major vegetables that is cultivated and consumed all over the world for a decade because of its flavor, aroma, nutrients and medicinal values (Bhattacharee et al., 2013). Aliero town is suitable for cultivation of many vegetables crops more especially *Allium cepa* due to the soil types, abiotic factors such as nitrate, moisture, sunlight and temperature which favors the germination of vegetable crops. Matured bulbs of *Allium cepa* contains both macronutrient and micronutrient elements that are found very essential for the normal metabolic activity of the human body and therefore helps in building the immune systems of human body (Jalani et al., 2010). Furthermore, immature or matured *Allium cepa* are used by rich and poor people in preparing many delicacy soup, dishes and sandwiches and can be cooked and served as vegetable.

Farming of *Allium cepa* provide jobs to both urban and rural people as consumers or producers, this also contribute in the development of Nigeria economy at large. Weed is an unwanted plant that grows where it is not needed and caused harm to the crop plants by competing with them for food, space and other abiotic factors such as air, soil, sunlight, minerals and water (Singh et al., 2006).

Since the human being tried to planted and cultivated various plants, weeds growth in an area selected to planting crops (Lambers et al., 2008). Many unwanted plant species are found distributed on the farm before, during growth phase and after cultivation of *Allium cepa* in Aliero due to abiotic factors that favored germination, growth and reproduction of weed plants species on agricultural lands. These weeds are found on agricultural land competing with any irrigating plants in order to obtain different elements for their survival (Singh et al., 2006). Different methods of controlling weeds are carried out all over the world for centuries such as manual, biological, cultural, chemical and mechanical (Hutchinson et al., 2011; Kunz et al., 2015 & Weber et al., 2016). However, these methods are applied separately or in combination depending on the farmers interest, nature of weeds, availability of equipment's, climatic conditions, soil types and most of all the plant species (cultivar). Onion's yield loss for 40-80% is caused by weed infestation due to increase and reduce water flow consumption between irrigated crops and weed species (Channapagoudar & Biradar, 2007).

Pathogens such as fungi, bacteria, nematode, pest and insects that attack vegetable crops during planting, growth phases and storage reduced the quality and yield of the crops. However, weeds are the major cause of low yield in *Allium cepa* in productivity due to slow germination, nature of the leaves that are narrow upright and do not shade out (Ujjainiya & Choudhary, 2019). The degree of damage caused by weeds is related to the type, species and density of weeds growing in a crop community. Species of weed are usually found distributed and this varies with season, availability of water, soil type and types of cultivar species in a particular field/farm or region (Ujjainiya & Choudhary, 2019). In Aliero, farmers prepared cultural weed control method due to availability of laborers, traditional equipments such as hoe and size of the farm. But hand weeding require huge amount of money for the control of weeds. Recently, in Nigeria, chemical such as bentaforce, pretilachlor + dimethametryn, oxadiazo, butachlor and piperophos were used and recommended as herbicide for the control of weeds (Imeakparia, 1990; Enyinnia, 1993).

The application of these chemicals depends upon the weed species that are expected or occur. Weed plant species do not only caused loss of *Allium cepa* but, also served as hosts to many pathogens and may cause diseases to the irrigated plants and reduction of yield and quality. Therefore, this study aimed to identify weed species, effect of cultural and chemical weed control methods on the yield and growth performances of *Allium cepa* (onion) in Aliero, Kebbi State, Northern-western Nigeria.

MATERIALS AND METHODS

Experimental site

The plantation of *Allium cepa* was conducted at Department of Plant Science and Biotechnology, Botanical Garden, Kebbi State University of Science and Technology, Aliero, Kebbi State.

Field experiment

The field was cleared, ploughed, harrowed and levelled. Basin and water channels were constructed accordingly. The area used for the experiment was measured as; 4.5 by 4.5 m ($11.25m^2$) in size and this was replicated three times. Block of size 2 x 1m was constructed with alley way of 0.5m between blocks. Inorganic fertilizers were applied based on specific instruction during the preparation of seed beds and four weeks after transplanting (Khokhar et al., 2004). Four treatment viz., control, integrated, chemical control and cultural with each treatment grouped then replicated four time in a randomized complete block design (RCBD). The first treatment was considered as control experiment and no weeding was done in second treatment both cultural and chemical practices were conducted, and in the third treatment only cultural method (hand weeding) was conducted and chemical method was carried out in the fourth treatment.

Figure 1. *Allium cepa* in one of the experimental field during watering

Sowing of seeds

Red onions seeds were sown 2 per hole at a depth of 2.5 cm using a spacing of 90 cm x 75 cm, with 1 m on each seed bed at botanical garden Departmental of plant science and biotechnology, KSUSTA. The bed was irrigated to field capacity with watering can twice daily (morning and afternoon) from sowing until two weeks after seedling emergence.

Seedling collection

Seedlings of red skinned onions were raised at Botanical Garden, Department of Plant Science and Biotechnology, Kebbi State University of Science and Technology, Aliero for 4-5 days in seedbeds before transplanting.

Bed irrigation

The beds were irrigated to field capacity with watering can twice daily (morning and afternoon) from sowing until two weeks after seedling emergence.

Transplanting

The seedlings were transplanted at a spacing of 15cm within row and 30cm between rows after 35 days. The vegetable irrigated was done immediately after transplanting and fertilizers were applied as adopted by Khokhar et al. (2004).

Seedling maintenance

Watering was done using generator and pumping machine after every 2-3 days interval as well as pest and disease control measures were done (Khokhar et al., 2006a).

Collection and sampling of weeds

Weeding was carried out at 5 and 9 weeks after transplanting by uprooting the encountered weed species. The weeds collected were preserved into vacuum box and taken to the laboratory in the Department of Plant Science and Biotechnology for local and scientific identification.

Identification of weed species

The weeds collected were identified by a taxonomist (Prof. Dharmendra Singh), Department of Plant Science and Biotechnology, Kebbi State University of Science and Technology, Aliero and voucher numbers were issued to each weeds identified. Each weed identified specimens was pressed, oven-dried at 40^{o}C for two weeks, and mounted on Herbarium sheets, which were then deposited at the department herbarium of KSUST, Aliero for future references.

Growth and measurements of Allium cepa

Growth parameters such as number of leaves, plant height, neck area, number of bulbs per plot and yield parameter were measured at 5, 7 and 9 weeks after transplanting.

Data analysis

The data collected were analyzed using descriptive statistic and one way variance (ANOVA) using SPSS version 17.

RESULTS AND DISCUSSION

Perusal of data in Table (1) show, 12 common identified weed species as; *Urenalo bata, Eragro stistremula, Amaranthus viridis, Senna occidentalis, Cenchruse chintus, Mitracarpus scaber, Commelina lanata, Zornia latifolia, Cassia tora, Sida cordifolia, Cleome viscose* and *Euphorbia thyamifolia*. However, *Urenalo bata* had the highest fresh weed weight and dry weed weight (35.20 & 33.10), followed by *Senna occidentalis* L. (34.00) fresh and (29.00) dry and *Zornia latifolia* was observed with least fresh and dry weight (3.30 and 1.10) among all the weeds found (Table 2). The height of *Allium cepa* varied in control, integrated, cultural and chemical methods during the initial seedlings to 9th weeks after transplanting as presented in (Table 3). Table 4 revealed that, cultural weed control had the highest neck area at 5, 7 and 9 weeks after transplanting 1.77^{a}, 1.97 and 0.45, followed by control 1.20^{a}, 1.49^{a} and 1.03^{ab}. However, at 5th weeks after transplanting of *Allium cepa* number of leaves were increased in all the treatments as control (3.23^{a}), cultural (3.00^{a}) and chemical (2.91^{a}) than integrated (3.33^{a}) and at 7th weeks after transplanting number of leaves were more significant in cultural method (3.69), integrated method (3.69) and control (3.61) while, cultural method (3.92), control (3.89), integrated (3.85), chemical (3.39) at 9th weeks after transplanting, respectively. The mean bulb weight with leaves were recorded with different values as control (40.77^{a}), integrated (59.79^{b}), cultural (67.22^{b}) and chemical (57.42^{b}) while in bulb without leaves cultural was observed (59.10) as the highest mean value, followed by integrated (55.00), chemical (52.66) and control (36.68) (Table 6). Table 7 revealed the number of bulbs per treatment with highest in cultural weed method (61.67^{c}), followed by chemical method (54.00^{b}), integrated (52.33^{b}) and control with lowest bulbs yield (45.33^{a}).

Weeds are the major plant species that caused huge loss to the farmers by reducing the yield and growth of their productivity during growth phase and harvesting. From the results obtained in this research study, a total of 12 weed species from different families were recorded and identified on the experimental fields namely; *Urena lobata, Amaranthus viridis, Senna occidentalis, Cenchruse chintus, Mitracarpus scaber, Commelina lanata, Zornia latifolia, Cassia tora, Sida cordifolia, Cleome viscose* and *Euphorbia thyamifolia*. Similar species were reported from Quetta velley Marwat et al. (1992) in

Table 1. Weed plant species identified and their family name

Scientific name	Local name or common name	Family
Urenalo bata	Garmani	Malvaceae
Amaranthus viridis	Rukubu	Amarntheceae
Ocimum grantissimum	Doddoyar gona	Lamiaceae
Senna occidentalis L.	Sanga sanga	Caelsapiniaceae
Cenchruse chintus L.	Karangiya	Poaceae
Mitracarpus scaber	Harwatsi	Rubiaceae
Commelina lanata Banth	Day flower	Commelinaceae
Zornia latifolia S.M	-	Fabaceae
Cassia tora	Tafasa	Ceasalpiniaceae
Sida cordifolia	Flannel weed	Malvaceae
Cleome viscosa L.	Namijin yar unguwa	Capparidaceae
Euphorbia thyamifolia L.	Sandmat	Euphorbiaceae

Pakistan (Khokhar et al., 2010). In addition, (Panse et al., 2014 & Gaharwar et al., 2017), reported some of these weeds species in their studies. The diversity of these weeds species in experimental field could be due to the sandy soil which is suitable for germination and growth of weeds, other abiotic factors, water, space give during planted and irrigated plants species e.g. *Allium cepa*. According to the findings of Abba et al. (2013), species of weeds reduce the growth and yield of vegetable crops including *Allium cepa* by competing with them for their survival during harvest which is in line with our findings. All these weed species observed during this field study were reported by Singh (2016), expected *Zornia latifolia* and *Ocimum grantissiumum* as weed species of Aliero Local Government Areas, Kebbi State, Nigeria. Also, Singh *et al*.

Figure 2. Images of some weed species encountered in the field

Table 2. Family, weed plant species identified and their weight (g)

Family	Weed species	Fresh weed weight (g)	Dry weed weight (g)
Malvaceae	*Urenalo bata*	35.20	33.10
Amarntheceae	*Amaranthus viridis*	19.00	14.00
Lamiaceae	*Ocimum grantissimum*	7.90	4.20
Caelsapiniaceae	*Senna occidentalis* L.	34.00	29.00
Poaceae	*Cenchrus echintus* L.	12.00	8.80
Rubiaceae	*Mitracarpus scaber*	7.80	4.30
Commelinaceae	*Commelina lanata* Banth	8.50	5.20
Fabaceae	*Zornia latifolia* S.M	3.30	1.10
Ceasalpiniaceae	*Cassia tora*	15.60	12.00
Malvaceae	*Sida cordifolia*	17.00	15.60
Capparidaceae	*Cleome viscose* L.	12.80	9.90
Euphorbiaceae	*Euphorbia thyamifolia* L.	8.20	6.10

Table 3. *Allium cepa* height (cm) from seedlings in all the treatments at 5, 7 and 9 weeks after transplanting

Treatments	5th weeks after transplanting	7th weeks after transplanting	9th weeks after transplanting
Control	9.67^{a}	10.22^{a}	11.00^{a}
Integrated	16.09^{b}	16.76^{b}	16.87^{b}
Cultural	18.72^{c}	19.97^{c}	20.01^{c}
Chemical	18.38^{c}	19.02^{c}	20.15^{c}
S.E±	2.56	12.705	2.574

N=3, values with different superscript showed significant difference ($P \leq 0.05$)

(2020), identified some of this species in his study salient features of diversity of weeds found in Maiyama local government area of Kebbi State, Nigeria. Nature, environmental factors and soil type found in Aliero are well suitable and supported the diversity and growth of unwanted plants. In additional, different cultivated lands with different crops might have different weed. The influents of these weeds on growth, germination and yield of onions were reported by different researchers in United Kingdom, Jordan and Pakistan (Bond and Burston, 1996; Qasem, 2005; 2006 and Khokhar et al., 2006).

Among all the treatments used in this study, the highest height of *Allium cepa* were obtained in treatment where cultural control measure was used followed by chemical, integrated and control having the lowest values. The plant heights were observed to be increasing from the initials (seedlings) but not in the integrated and control where onions height is significantly ($P \leq 0.05$) depressed by weeds. These agreed with the findings of Kumari et al. (219), that reported (24.3cm) as the height of *Allium cep*a. Tomatoes height was also reduced by the presences of weed species at 7th and 9th weeks after transplanting (**Ibo** et al., 2008). According to Glaze (1987), stated that onion crops must be kept free of weeds for a long period after transplanting in order to avoid significant yield losses. This indicates that, hand weeding reduced competitions among vegetables crop and allowed better growth due to availability of minerals found in the soil with no effect on it.

Moreover, (Table 3 & 4), revealed that neck are of *Allium cepa* were influenced by integrated and cultural methods of weeds control. The results were significantly different and statistically highest ($P \leq 0.05$) neck area was observed in integrated and cultural treatments and the control had the least neck area. Number of leaves on *Allium cepa* as affected by the treatments (Table 4) revealed significantly higher number of leaves at 5th weeks after transplanting in integrated, control and cultural than chemical. This may be due to the fact that onions produced much leaves at early stage between 1-5 weeks after transplanting hence, there is less competition with weeds due to the clearing of the field before transplanting. This is in agreement with the findings of (Gaharwar et al., 2017). But at 7th weeks after transplanting number of leaves were observed more in cultural than control and chemical treatment. While, in control, it was more significant than in integrated, cultural and chemical at 9th weeks after transplanting. Weeds species on onions plots had implications of reduced plants heights, number of leaves, which in turn reduced the bulb diameter and bulb yields due to increased competition (Singh et al., 1997). Therefore, leaf number, leaf area index were highest when there was proper

Table 4. Neck area (cm) of *Allium cepa* at 5, 7 and 9 weeks after transplanted (WAT)

Treatments	5th weeks after transplanting	7th weeks after transplanting	9th weeks after transplanting
Control	1.19[a]	1.37[a]	1.44[ab]
Integrated	1.31[a]	1.83[a]	1.89[b]
Cultural	1.77[a]	1.97[a]	0.45[a]
Chemical	1.20[a]	1.50[a]	1.03[ab]
S.E±	0.373	0.315	0.457

N=3, values with different superscript showed significant difference ($P \leq 0.05$)

Table 5. Increase number of leaves of *Allium cepa* at 5, 7 and 9 weeks after transplanted

Treatments	5th weeks after transplanting	7th weeks after transplanting	9th weeks after transplanting
Control	3.23[a]	3.61	3.89
Integrated	3.33[a]	3.68	3.85
Cultural	3.00[a]	3.69	3.92
Chemical	2.91[a]	3.28	3.39
S.E±	0.482	0.527	0.570

N=3, values with different superscript showed significant difference ($P \leq 0.05$)

Table 6. Diameter of *Allium cepa* Bulb (Weight)

Treatments	Bulb weight with leaves (g)	Bulb weight without leaves (g)	Bulb diameter (cm)
Control	40.77[a]	36.68	12.29[a]
Integrated	59.79[b]	55.00	14.37[b]
Cultural	67.22[b]	59.10	14.99[b]
Chemical	57.42[b]	52.66	14.35[b]
S.E±	6.773	6.269	0.634

N=3, values with different superscript showed significant difference ($P \leq 0.05$)

Table 7. Number of *Allium cepa* bulb per treatment

Treatments	Bulb yield in number
Control	45.33[a]
Integrated	52.33[b]
Cultural	61.67[c]
Chemical	54.00[b]
S.E±	3.355

N=3, values with different superscript showed significant difference ($P \leq 0.05$).

and regular weeding. This finding collaborated with the finding of Gloria & Edulusi (1998) who reported that, irrigated plant species that compete with unwanted weeds would produce less number of leaves, leaf size, leaf area and leaf area index. Also, height, numbers of leaves, fresh and dry weight of plant were found to be higher under weed free condition (Sharna & Khandwe, 200). According to the reports of Gaharwar et al. (2017), increase in number of weeds results to competition among the cultivated crops (*Allium cepa)* and this may cause stress. Cultural method of controlling weeds was recorded with the highest value of bulbs weight (67.22^{b}) due to minimum weeds in the experiment fields. These were higher than the values obtained by (Dhanananivetha et al., 2015). Nair et al. (1980), observed that, the presence of weeds reduced the bulb size of *Allium cepa.* These findings agreed with the work of different researcher around the world that reported higher bulb weights on chemical method (Marwat et al. 2003; Ghaffoor, 2004 and Khokhar et al. 2006b). Furthermore, the results obtained in cultural and chemical methods were found to decrease the population and effect weeds significantly as compared to the control plot. Different researchers such as Rathore et al. (1990) & Singh & Chandel (1995), reported the same during harvesting of soybean. Presences of weed species in the vegetables crop field effect inversely the yield quality of this perishable crops.

CONCLUSION

Knowing the unwanted plant species in any agricultural land is the one of the fundamental step that provide the control measures to be taking in controlling this weeds as well as the favorable methods to use. From this study, 12 species of weed were obtained and identified in the experimental field such as; *Urenalo bata, Eragro stistremula, Amaranthus viridis, Senna occidentalis, Cenchruse chintus, Mitracarpus scaber, Commelina lanata, Zornia latifolia, Cassia tora, Sida cordifolia, Cleome viscosa* and *Euphorbia thyamifolia* which caused poor performance of irrigated *Allium cepa* in the study area. It can be concluded that, hand weeding is the best method among all the methods used in controlling weeds when properly done. Hence, with this method, high yield of *Allium cepa* could be obtained with minimum atmospheric damage. *Allium cepa* farmers should adopt early weeding after sowing or transplanting to reduce weed compete with onion crops in Aliero local government area and Nigeria at large.

AUTHOR CONTRIBUTIONS

This field work research was carried out in collaboration with both authors. The author Mubarak Aminu provide all the chemicals and equipment used in this study as well as cultivation of the *Allium cepa* under the supervision of Dr. Jibrin Naka Keta. Manuscript was compiled by Mubarak Aminu and both authors read and approved the final manuscript.

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COMPETING INTERESTS

The authors have no conflict of interests.

ETHICS APPROVAL

Not applicable

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