UTILIZING WEEDS AS A SOURCE OF ORGANIC FERTILIZER FOR IMPROVING OKRA (*Abelmoschus esculentus* L.) YIELD ATTRIBUTES

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DOI 10.28941/pjwsr. v28i4.1097

ABSTRACT

Utilizing weeds as a source of organic fertilizers greatly contribute to the vegetables production, particularly in organic farming. This study aimed to explore the potential of weeds as organic fertilizers in okra crop. The hypothesis was that it could effectively substitute synthetic fertilizers and be integrated into ecological farming. A pot experiment was carried out during kharif season (2020) at district Charsadda (34° 14' 18.67'' N, 71° 43' 28.12'' E), Khyber Pakhtunkhwa. Aqueous extracts (250 ml) from 10 different weeds were prepared and Tape water was considered as control for comparison. The experiment was implemented in completely randomized design (CRD) replicated four times having 11 treatments viz; T1 (*Parthenium hysterophorus*), T2 (*Urtica dioca*), T3 (*Convolvulos arvensis*); T4 (*Taraxicum officinale*), T5 (*Euphorbia helioscopia*), T6 (*Cynodon dactylon*), T7 (*Cyperus rotunus*), T8 (*Cannabis sativa*), T9 (*Silybum marianum*) T10 (*Rumex crispus*), T11 Tape water (control). Aqueous extract of each weed was applied to polythene bags containing 4 kg soil. Okra seeds of 'Sabz Pari' variety were sowed in polythene bags in April 2021. The results indicated that *E. helioscopia* and *C. arvensis* increased plant height of okra by 45% and 46% as compared to tape water. *R. crispus* and *C. sativa* increased number of leaves by 52% and *U. dioica* by 50%. Moreover, *U. dioica* increased the number of pods plant^{-1} by 19%, 28% and 36% as compared to tape water, *C. rotundus* and *C. arvensis* respectively. Similarly, *U. dioica* increased pod length by 30% and 34% compared to tap water and *C. arvensis* respectively and increased pod weight by 42%, 48% and 53% compared to Tap water, *C. arvensis* and *C. rotundus* respectively. Consequently, the effect of *U. dioca* was significant on increasing okra growth attributes and yield. The results of present study contribute considerably to new knowledge on weeds-based organic fertilizer. Furthermore, field trials are needed to evaluate weeds aqueous extract as a source of organic manure in okra at different ecological zones.

Keywords: Organic farming, Stinging nettle, weeds-based fertilizer, weeds utilization, etc.

Citation: Khan, A. S., M. A.khan, M. Fawad and M. Sadiq. 2022. Utilizing weeds as a source of organic fertilizer for improving okra (*Abelmoschus esculentus* L.) yield attributes. Pak. J. Weed. Sci. Res., 28(4): 447-456.

INTRODUCTION

Okra scientifically known as *Abelmoschus esculentus* L. belongs to the family Malvaceae. It is a significant vegetable crop that is grown for its green, soft fruits and used in several ways as cooked vegetables (Miaha et al., 2020). Okra is an annual leafy vegetable crop grown mostly as fruits; rich in Vitamins, Calcium, Potassium, plant protein and minerals (Eke et al., 2008; Arunnaik et al., 2008. It can be fried, cooked, used to thicken the soup, or served with rice, and other dishes when combined with the proper ingredients. The delicate fruits can be

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boiled, chopped up, and eaten with soup. Moreover, it is beneficial for diabetes and some cancers. Mature fruit stems containing 20% protein, edible oil and crude fiber and mucilage are used for medicinal purposes (Badrie, 2016; Aboyeji et al., 2021). Okra originated in India and is cultivated as a warm-season crop globally (Rao, 1989). In Southeast Asia, India, West Africa, Brazil, Southern United States, northern Australia and Turkey okra is a conventional vegetable crop that is grown for commerce. It is grown in warm, temperate, and tropical regions globally (Singh et al., 2018).

Okra is considered the native vegetable crop of Pakistan which is grown throughout the country (Sheikh et al., 2012). Pakistan produces 1.3% of the world's okra and is ranked the fifth-largest producer of okra globally. Pakistan exports excess okra to other countries, including Malaysia, Iran, Afghanistan, and the United Arab Emirates (GOP, 2019). The average output of green pods per area in the nation is still low, despite the generally favorable climatic conditions for its growth (Amjad *et al*., 2001; Chattopadhyay et al., 2011). Inadequate plant nutrition is one of the key factors affecting okra growth and yield. Proper nourishment, daylight and humidity are essential for optimal crop growth and productivity (Ezeakunne, 2004; Kusvuran, 2012). Fertilizers are frequently used on crops to increase their production, growth, nutritional value, and attractive appearance (Smriti et al., 2018). The application of synthetic fertilizers to increase soil fertility has become an important component of the global food supply (Saini et al., 2020). With the increasing population, small land holdings, the farmers try to use high prices on fertilizers for increasing crop production. Synthetic fertilizers are frequently used and are an effective option for producing a high yield. However, the intended use of synthetic fertilizer depletes soil fertility causes soil sickness and disturbs the soil microbiome. In the modern era organically grown vegetables are popularized, safe and acceptable all over the world. Though It requires the replacement of the present strategy that is based on some holistic weeds-based organically and eco-friendly fertilizers, which is more efficient and feasible for sustainable agriculture.

In general plants have a variety of phytochemicals that might significantly inhibit or improve the growth of another plant. Most of the plants which are considered weeds are allelopathic due to the secretion of secondary metabolites to the nearby environment and inhibit the growth of nearby plant populations. However, some weeds aqueous extracts at certain concentrations are growth regulators in nature which enhances crop productivity. Natural growth regulators, often known as phytochemicals, can change how a plant grows morphologically and can influence how well or how quickly a plant grows from seed to mature plant (Das and Das, 1995; Shahid et al., 2013). Fertilizers from an organic source are also a rich source of nitrogen, phosphorus and potassium which play essential for chlorophyll formation, photosynthesis and respiration and nutrient transportation in plants and improve crop productivity (Sharma et al., 2017).

In agro-biodiversity weeds are considered as one of the major biotic constraints by interfering with crops and causing yield losses. Utilizing weeds as organic fertilizer is an innovative strategy to enhance crop production; this approach is safe and eco-friendly having no residual effect. The intended use of synthetic fertilizers, and pesticides rises very quickly which exert pressure on the ecosystem and biodiversity. We must implement all secure and healthy strategies for the enhancement of our ecology and biodiversity to reduce stresses. Organic agriculture is recommended as an ecological technique to produce nutritious, healthier and economical food and to restore soil fertility through weeds-based fertilizer. The world's population is expanding, and one of the biggest challenges we face right now is providing enough wholesome, balanced meals for everyone. However, organic fertilization is a novel and unique strategy for increasing crop production. The organic fertilizers from the source of the weed are used as soil amendments which not only enhance soil nutrient status but also diminish the prevalence of pest. Therefore, this study conceived to evaluate certain weeds

aqueous extract as a source of organic fertilizer for improving okra yield.

MATERIALS AND METHODS:

A pot experiment was carried out during the Kharif season 2021 at district Charsadda, (34° 14' 18.67'' N, 71° 43' 28.12'' E) Khyber Pakhtunkhwa. The study aimed to utilize weeds as organic fertilizers in okra crop. Seeds of the Okra variety 'Sabz Pari' were sowed in plastic pots in April 2021. The experiment was implemented in a completely randomized design (CRD) and replicated four times having 11 treatments viz; T1: (*Parthenium hysterophorus*), T2: (*Urtica dioca*), T3: (*Convolvulos* arvensis); T4: (*Taraxicum officinale*), T5: (*Euphorbia helioscopia*), T6 (*Cynodon dactylon*), T7: (*Cyperus rotundus*), T8: (*Cannabis sativa*), T9: (*Silybum marianum*) T10: (*Rumex crispus*), T11: (control). All the weeds were collected and weed fresh biomass of 1 kg for each specie was dipped in 1 liter of water for 25 days and an aqueous extract was prepared. Okra variety "Sabz Pari" 3 seeds were sowed 2 inches under the soil in each plastic pot of uniform size and weight.

Following treatments were applied as aqueous extract.

Treatments	Common name	Local name	Botanical name	Family
1	Santa maria	Gajar booti	*Parthenium hysterophorus*	Asteraceae
2	Stinging neetle	Bicho booti	*Urtica dioca*	Urticaceae
3	Field bindweed	Prewatay	*Convolvoulus arvensis*	Convolvulaceae
4	Common dandelion	Zyar goly	*Taraxicum officinale*	Asteraceae
5	Bermuda grass	Kabal	*Cynodon dactylon*	Poaceae
6	Hemp	Bhang	*Cannabis sativa*	Cannabaceae
7	Curly dock	Shalkhy	*Rumex crispus*	Polygonaceae
8	Nut grass	Dheela	*Cyperus rotundus*	Cyperaceae
9	Sun spurge	Gandhi booti	*Euphorbia helioscopia*	Euphorbiaceae
10	Milk thistle	Ont katara	*Silybum marianum*	Asteraceae
11	Control (Sterilized tape water)			

Parameters studied

Data was recorded during okra maturity; measuring tape was used for determining plants height (cm). Other growth parameters including the number of leaves plant^{-1}, pods plant^{-1} and pod length (cm) were recorded manually. However, pod weight was determined by a digital weighing scale and mean data for each variable was computed.

Plant height (cm)

Okra plant height was recorded by using a measuring tape, the height of okra in each treatment and their replication was recorded, and the average plant height was computed.

Number of leaves plant^{-1} of okra

The number of leaves of each okra plant was counted in all the treatments, and the average data was computed.

Pod weight (g)

Pods were picked from each treatment, till harvesting. Pod weight was recorded through digital balance and the average data was computed.

Pod length (cm)

Fresh pods were collected randomly from each treatment during maturity and pod length was measured with the help of a simple ruler and then means data was computed.

Number of pods plant^{-1}

Number of pods plant^{-1} was counted and mean pods number was recorded for all the treatments and their replicates.

Statistical Analysis

The data for all the morphological attributes of okra were subjected to a one-way Analysis of Variance (ANOVA) technique suitable for completely randomized design (CRD) by using Statistix 8.1 package. Wherever the F value was found significant, the Least significant differences (LSD) test was carried out at *P<0.05* to separate the means for each treatment (Steel and Torrie 1980).

RESULTS AND DISCUSSIONS

Plant height (cm)

Analysis of data shows various aqueous weeds extract significantly affected plant height of okra (Figure 1). Among the aqueous extracts taller plants (28.7 cm) were produced with the application of *C. arvensis* followed by *E. helioscopia* with plant height (28 cm). While, lowest plant height was recorded in tape water (15.5 cm) and *C. sativa* (16.7 cm). The data shows that higher plant with the application of *C. arvensis* and *E. helioscopia* aqueous could be due to phytochemical combination which encourages plant height while the lowest plant height in the tape water could be due to no nutrients availability. In the same way the dwarf plant height with the *C. sativa* aqueous extract might be due to its phytochemical constituents which negatively affect the plant height of okra. Phytochemical constituents are varied in different weed species. Some plant aqueous extract inhibit shoot growth while other promotes shoot growth. Moreover, the efficacy of aqueous weed extracts as organic fertilizer greatly depends on the dosage and persistence in the soil. Interestingly, plant treated with weeds-based organic fertilizers tended to more continuous growth and significantly higher plant height as compared to the control (tape water). Plant height was considerably increased with the application of *C. arvensis* aqueous extracts. This could be due to an increase in the accessibility of nutrients to the plants or by amending the soil physio-chemical properties which could be more feasible for plant growth. *C. arvensis* aqueous extracts provides suitable environment for the optimum vegetative growth of okra and ultimately increased plant height of okra. Comparable results have been revealed by Nyangani (2010) in different field crops. Similarly, Tanveer et al., (2021) resulted an increased in plant height of okra crop with the application of weeds-based organic fertilizers.

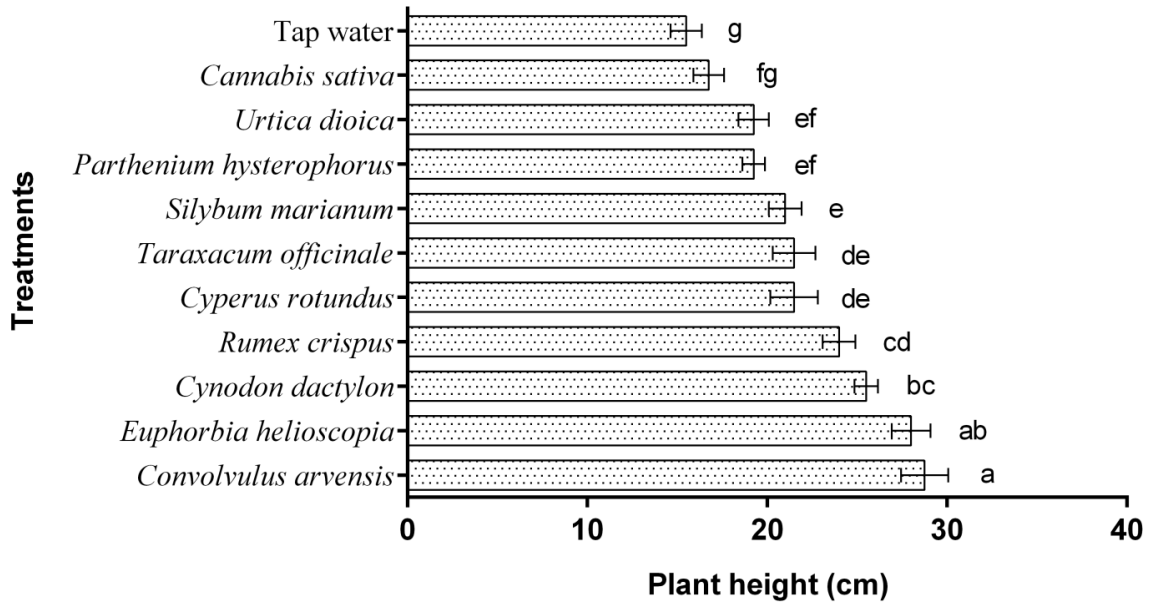

Figure 1. Effect of various weeds aqueous extracts on plant heights (cm) of okra. Column graph±SE followed by different letters are statistically different at 5% probability level.

Number of leaves plant^{-1}

Statistical analysis of data revealed that aqueous extracts of different weeds significantly affected the number of leaves plant^{-1} of okra. Comparison of mean at *P<0.05* for LSD test was 1.55. The mean data indicated that highest numbers of leaves plant^{-1} of okra (5.2) was recorded for *R. crispus*, *C. sativa*, *U. dioica*, *C. rotundus* and *C. arvensis* which were statistically comparable. While lowest number of leaves plant^{-1} of okra (2.5) was recorded in tape water and *P. hysterophorus* aqueous extract. The number of leaves has a direct impact on photosynthesis since more leaves allow for increased photosynthetic activity, which in turn impacts the yield. In order to form bulbs, the photosynthetic material produced in the leaves largely passes down to the root zone. Therefore, the increased number of leaves in okra with the aqueous extract application might be due to high nutritional composition of *R. crispus*. Weeds instead of being harmful by competing with crop for the same resources could also be utilized as a source of green manure. Conversely, variation in nutrient content among weed type is well-known and is influenced by the developmental stage and ecotype. Setyowati et al., (2015) studied the effect of plant-based organic fertilizer from Wedelia source and found that wedelia compost significantly substitute nitrogen, Phosphorus, potassium fertilizer for growth and productivity of mustard. In a comparable finding by Setyowati et al., (2017) reported that Siam and Wedelia weeds compost at the rate of 20 ton ha^{-1} increase productivity of chili pepper as compared to the sole application urea. Similarly, Kujur and Rajiv (2021) examined the influence of organic fertilizers and found that organic amendments in garlic crop considerably increased number of leaves plant^{-1} in garlic. Therefore, in light of the results and previous the findings of various researchers investigating weed-based organic fertilizer, it is concluded that weeds, rather than being unwanted, might be utilized as a valuable fertilizer source for organic cultivation of okra crop.

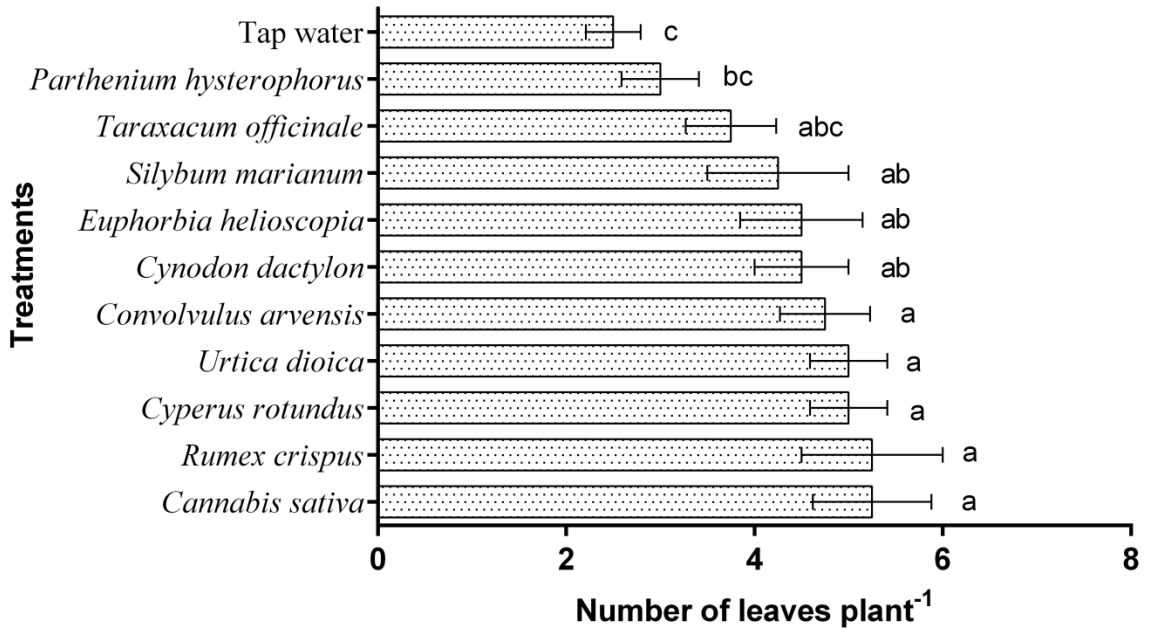

Figure 2. Effect of various weeds aqueous extracts on number of okra leaves plant^{-1}. Column graph±SE followed by different letters are statistically different at 5% probability level.

Number of pods plant^{-1}

Analysis of data indicated that highest number of pods (20) was produced by the *Urtica dioca* extract, followed by *R*. *crispus* (17 pods) while, lowest number of pods 13 and 15 was recorded with the application of *C. arvensis* and *C. rotundus* respectively. Our results show that treatment of (*Urtica dioca*) result a significant increase in the number of pods per okra plant. The relative increase in the pods number of pods of okra plant could be due to the application of *U. dioica* amendments which delivered the essential nutrient to the garlic crop for its metabolic functions. These outcomes are in agreement with the results of Shahid et al. (2013) they observed that the growth, yield and seed number of okra can be affected by using plant-based organic manure. Organic fertilizers were seen effective in influencing pod weight, pod diameter and pod number and yield of okra. Therefore, aqueous extract of *U. dioica* can be applied as a good source of organic fertilizer for increasing pod number and yield of okra.

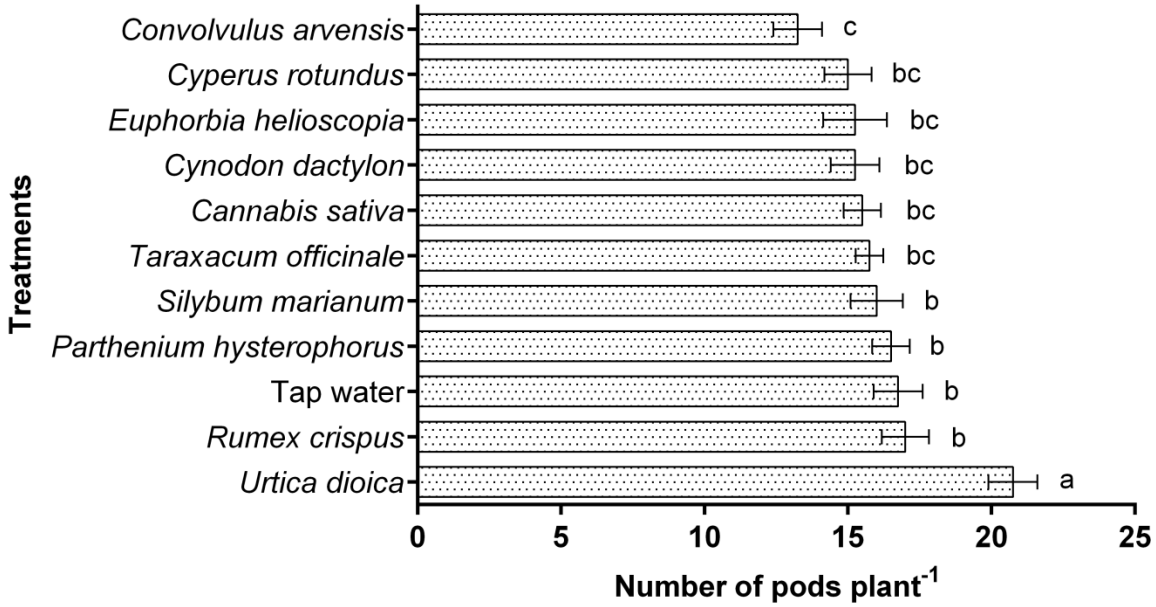

Figure 3. Effect of various weeds aqueous extracts on number of pods plant^{-1} of okra. Column bar±SE followed by different alphabetical letters are statistically different at 5% probability level.

Pod length (cm)

Analysis of the data exhibited that aqueous extract of several weed species had a considerable impact on the okra pod length. Data regarding pod length plant^{-1} of okra is presented in Figure 3. The data shows that aqueous extract of *U. dioica* produced maximum pod length (12.5 cm) followed by *P*. *hysterophorus* (10.25 cm). Similarly aqueous extract of *C. arvensis* produced the minimum pod length (8.2 cm) followed by Tap water with pod length (8.8cm). The less pod length with application of *C. arvensis* could be due the allelopathic effect which might reduce pod length of okra as compared to tape water. Moreover, the maximum pod length of okra could be attributed to high nutritional composition of *U*. *dioica*. Our results are in line with the results of Rivera et al., (2012), they claimed that the aqueous extract of stinging nettle is a rich source of nitrogen, phosphorus, magnesium, iron and calcium which considerably promote plant growth. In a similar study by Ibukunoluwa (2007) stated that plant residues can be used as organic fertilizer, which considerably increase soil fertility, root growth and pod length of okra. Similarly, Akande et al., (2010) observed that plant growth was stimulated when

Gliricidia leaves were applied as organic fertilizer compared to the untreated controls. Interestingly, the obtained yield is comparable to those achieved with a combination of organic and mineral fertilizer. Hence, the present organic amendments prominently increased okra pod length and could be suggested as a best organic fertilizer.

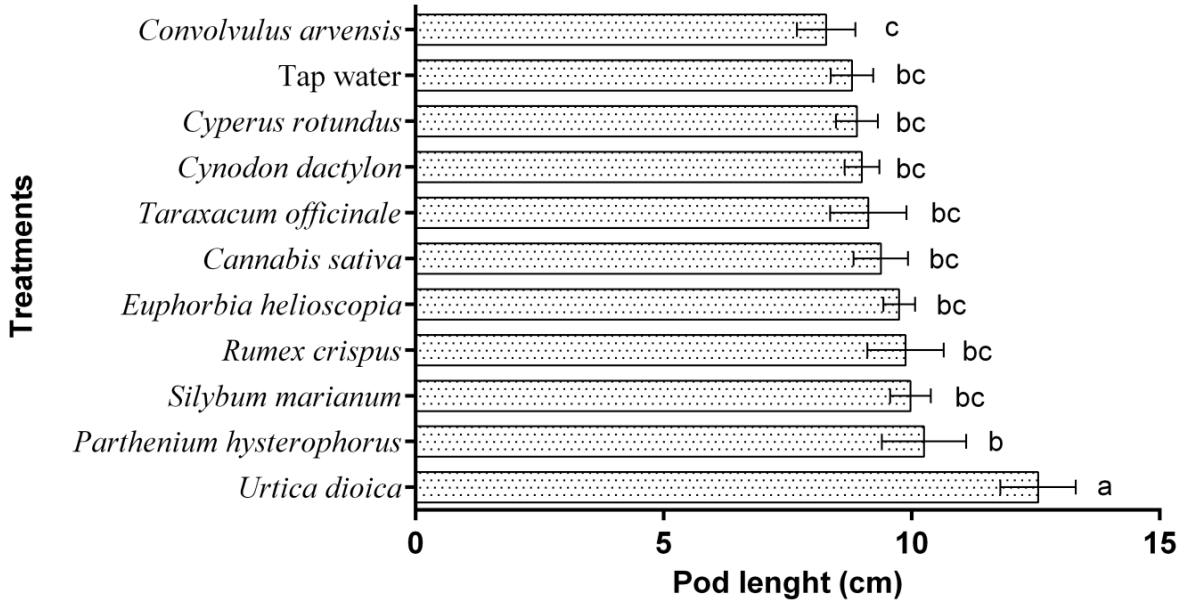

Figure 4. Effect of various weeds aqueous extracts on pod length (cm) of okra. Column graph±SE followed by different alphabetical letters are statistically different from each other at 5% probability level.

Pod weight plant^{-1}(g)

Mean data concerning pod weight of okra is presented in Fig. 5. Analysis of data revealed that effect of various weeds extracts significantly increased pod weight of okra. The data shows that highest pod weight plant^{-1} (797 g) was recorded in *U. dioca* followed C. sativa and *P. hysterophorus* with pod weight (664 g) and (633 g) respectively which are statistically comparable. While, minimum pod weight was recorded in *C. rotundus* (375 g) followed by *C. arvensis* (414 g). Apparently, plant-based organic fertilizer has significantly increased number of leaves, pod weight and height up to major extant. The findings of Zulfiqar et al., (2020) also revealed that plant-derived bio-stimulants promote the growth and productivity of a wide range horticulture crops through increasing the physiological, biochemical molecular activities of plants. In similar study Tiamiyu et al. (2012) observed that organic fertilizer increased plant height, number of leaves, pod weight. Moreover, okra pod weight has a positive and direct correlation with yield attributes (Balakrishnan and Sreenivasan 2010; Tanveer et al. 2021) which may be due organic amendment to the soil and improved yield components. Similarly, Adekiya et al., (2019) declared that organic amendment of plant-based fertilizer improve plant growth, nutritional quality and yield of okra crop.

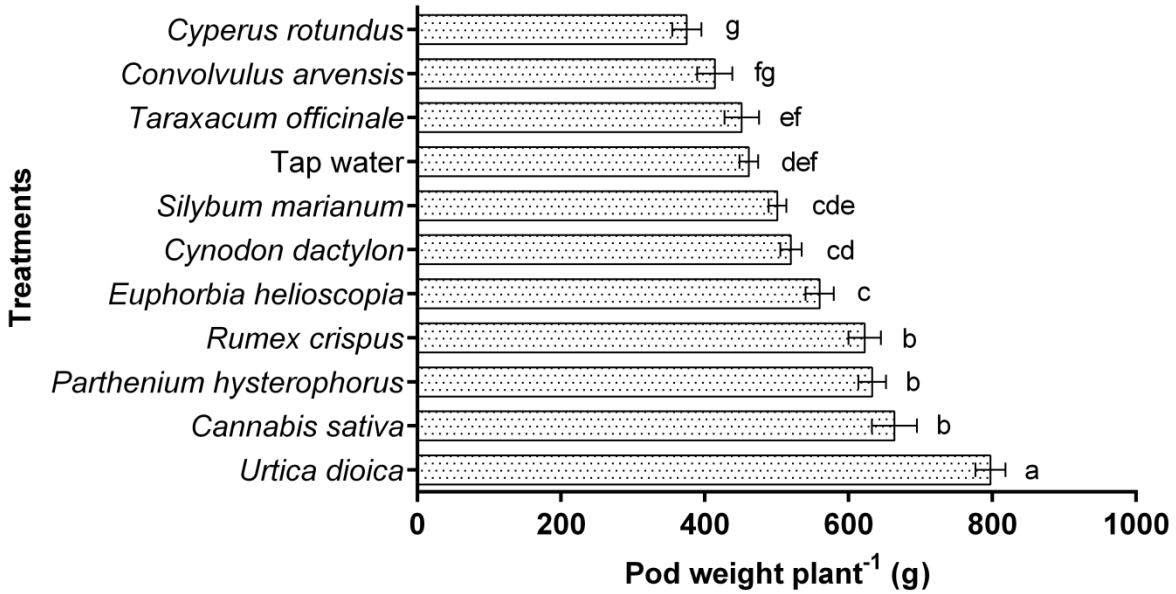

Figure 5. Effect of various weeds aqueous extracts on pod weight plant^{-1} of okra. Column graph±SE followed by different alphabetical letters are statistically different from each other at 5% probability level.

CONCLUSION

Okra is an important and nutritious vegetable crop, efforts have been made on how to increase okra yield. Exploiting weeds as organic soil amendment is necessary for improving okra productivity. Statistical analysis of variance for phenotypic and yield variables of okra responded well to the application of Stinging nettle (*Urtica dioca* L.) aqueous extract which considerably increase final productivity as compared to other weeds extracts. Moreover, weed-based fertilizer will minimize cost of production; improve soil organic matter, nutrient availability to the plants, and will ultimately improve okra yield. Therefore, stinging nettle aqueous extract is recommended as best organic source of fertilizer which achieved highest yield of Okra. Furthermore, the same experiment should be evaluated in field trails to find complete efficacy of stinging nettle.

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