



Research Article

HERBICIDAL OPTIONS IN MANAGING WEEDS TOWARDS GROWTH AND YIELD DYNAMICS OF SINGLE CLOVE GARLIC

MALLIK S*, SHARANGI A. B. AND DATTA N.

Department of Spices and Plantation Crops, Faculty of Horticulture, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, 741252, Nadia, West Bengal India

*Corresponding Author: Email-smallikbckv90@gmail.com

Received: December 28, 2016; Revised: January 02, 2017; Accepted: January 03, 2017; Published: January 06, 2017

Abstract- A field experiment was conducted at the HRS, Mondouri, Bidhan Chandra Krishi Viswavidyalaya, Nadia from during 2013-14 and 2014-15, to study the effect of weed control methods on weed population dynamics, their effects on yield and quality in garlic (Single clove). The treatments were Oxyfluorfen 23.5% EC (Gola) applied before sowing and at 60 DAS, Pendimethalin 30% EC (Stomp) applied before sowing and at 60 DAS, Quizalofop Ethyl 5% applied before sowing and at 60 DAS, Oxyfluorfen 23.5% EC applied before sowing + one hand weeding (HW) at 45 DAS, Pendimethalin 30% EC applied before sowing + one HW at 45 DAS, Quizalofop Ethyl 5% applied before sowing + one HW at 45 DAS, Combined spray of Quizalofop Ethyl 5% and Oxyfluorfen 23.5% EC at sowing and at 60 DAS, Combined spray of Pendimethalin 30% EC and Quizalofop Ethyl 5% at sowing and at 60 DAS, Weedy check (Control). The most predominant weed flora were *Chenopodium album*, *Chenopodium murale*, *Convolvulus arvensis*, *Parthenium hysterophorus*, *Cyperus rotundus* and *Euphorbia hirta*. For controlling weeds and maximum WCE%, highest bulb yield, high TSS, Vit C and antioxidant and minimum weight loss during storage (g) was found with Pendimethalin 30% EC applied before sowing + one HW at 45 DAS was found to be the best herbicides as compared to control and other herbicides. Weed reduced the garlic bulb yield by 46% over the best treatment Pendimethalin 30% EC applied before sowing + one HW at 45 DAS.

Keywords- Garlic, Weed, Herbicide, Growth, Yield

Citation: Mallik S., et al., (2017) Herbicidal Options in Managing Weeds towards Growth and Yield Dynamics of Single Clove Garlic. International Journal of Agriculture Sciences, ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 9, Issue 1, pp.-3627-3630.

Copyright: Copyright©2016 Mallik S., et al., This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution and reproduction in any medium, provided the original author and source are credited.

Academic Editor / Reviewer: Tanmoy Sarkar

Introduction

Garlic (*Allium sativum* L.) belongs to the family liliaceae and is the second most widely used *Allium* next to onion. The garlic plant is bulbous, hardy, perennial, producing narrow and flat leaves. The flavor of garlic is more powerful than that of the other bulb crops. Generally garlic contains several cloves, but Single clove of garlic has only one clove. The size of single clove differs from approximately 25 to 50 mm in diameter and it is bright white in color. It originates in Yunnan province in Southern china. It has the flavor of the garlic clove but is somewhat milder and slightly perfumed. Many people believes that single clove of garlic have more nutritive value than multiple clove of garlic.

It is especially rich in protein, carbohydrate and ascorbic acid. About 142 calories of energy is obtained from 100 gram of garlic. Garlic has higher nutritive value than other bulb crop [1]. It is recommended for breathing problems, cancer, blood pressure, flatulence, leucoderma and skin diseases. Garlic also reduces the levels of lipid, cholesterol and sugar in blood due to presence of allicin. Allicin is considered the major antioxidant and scavenging compound, studies are showing that other compounds may play stronger roles [2]. The productivity of garlic is very low due to some problems like unavailability of good planting material, improper agronomical practices and disease and pest attack. Weed in garlic are global problem and losses due to weed competition were as high as 30 - 60% [3, 4]. Several morphological and physiological features of garlic viz. short stature, non branching habit, sparse foliage, shallow root system and slow growth at initial stage etc, and the faster rate of growth of the weeds make the crop vulnerable to weed attack particularly during the initial stages of growth. [4, 5]. Controlling weed

infestation during the garlic crop cycle is essential to obtain high yields and marketable product. Garlic does not compete well with weeds; they are slow growing and suffer from successive flushes of weed. They have narrow upright leaves, which do not shade out weeds that emerge. Weed control in garlic is particularly problematic, so early season weed control is critical for successful garlic production. Single hand weeding is not sufficient to control weed as manual weeding is also very tedious and expensive laborious method of weed control. So, it is essential to use herbicides. Pendimethalin [6], Oxyfluorfen [7, 8], Quizalofop ethyl were found effective for managing weeds in garlic. Single application of any of herbicide is not sufficient to obtain yield equal to weed free treatment [6, 9]. Few herbicides had phytotoxic effect on garlic crop therefore hand weeding in combination with herbicides provided good result for weed control and garlic yield [10]. [11, 12] reported that different weed control methods had a substantial effect on crop yield. The study was therefore taken up to find out a suitable herbicide with proper effective dose to control weeds in garlic and to study the effect of different herbicides on the growth, yield and quality of garlic.

Materials and Methods

The present experiment was conducted in winter seasons of 2013-14 and 2014-15 in humid subtropical regions of West Bengal to study the weed dynamics in single clove of garlic (cv. Mohanpur Local) and its effective control measures by the use of chemicals and hand weeding. The present experiment was conducted at the Horticultural Research Station Mondouri, Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal. The farm is located very close to the Topic of Cancer having

approximately 23.5°N latitude and 89.0°E longitude. The altitude of the place is about 9.75 m above the sea level. pH, total nitrogen, available phosphorus and potassium and organic C of the field are 6.9, 0.05%, 21.11 and 178.80 kg ha⁻¹ and 0.41% respectively). The experimental site was on a highland with assured drip irrigation facilities and adequate drainage facilities. The experiment was laid out in Randomized Block Design (RBD). Plot size was 1.5X1.2 m². The trial comprised of the following nine treatments, viz. T1: Oxyfluorfen 23.5% EC (Gola) applied before sowing and second at 60 Days after sowing, T2: Pendimethalin 30% EC (Stomp) applied before sowing and second at 60 days after sowing, T3: Quizalofop Ethyl 5% applied before sowing and second at 60 days after sowing, T4: Oxyfluorfen 23.5% EC (Gola) applied before sowing + one hand weeding at 45 days after sowing, T5: Pendimethalin 30% EC (Stomp) applied before sowing + one hand weeding at 45 days after sowing, T6: Quizalofop Ethyl 5% applied before sowing + one hand weeding at 45 days after sowing, T7: Combined spray of Quizalofop Ethyl 5% and Oxyfluorfen 23.5% EC (Gola) at the time of sowing and second at 60 days after sowing, T8: Combined spray of Pendimethalin 30% EC (Stomp) and Quizalofop Ethyl 5% at the time of sowing and second at 60 days after sowing, T9: Weedy check (Control). Land was prepared and recommended dose (25 tons ha⁻¹) of FYM was incorporated into the soil. NPK were applied @ 100:50:50 kg ha⁻¹ using urea, single super phosphate (SSP) and muriate of potash (MOP) respectively. Full doses of phosphorus and potassium and half dose of nitrogen were applied before sowing, while remaining dose of N was added 30 DAS. Garlic cultivar was sown on 13th November, 2013 (year 1) and 13th November, 2014 (year 2). Spacing was 15 cm X 10 cm.

Data Collection and Analysis

Several weed related observations like weed density (number of weeds m⁻² area), fresh weeds biomass (g m⁻²), dry weeds biomass (g m⁻²), bulb weight (g), bulb diameter (cm), bulb length (cm), clove per bulb, bulb yield/ ha (tons) throughout the period of experimentation. The bulb yield of garlic was recorded (kg) in each plot and then converted to tons/ha. And also the quality parameters like TSS (total soluble solid), Vit. c (mg/100g) [13], RSA% (radical scavenging activity) and loss of weight during storage. For taking dry weights, the fresh weeds were kept in electric oven (set at 60°C) for three days until brittle and then the dry weight was recorded. The data recorded were statistically analyzed using statistical software SPSS 16.0.

Results and Discussion

Weed Density (m⁻²)

The most predominant weed flora in the experiment field were *Chenopodium album*, *Chenopodium murale*, *Anagallis arvensis*, *Convolvulus arvensis*, *Parthenium hysterophorus*, *Spergula arvensis*, *Cyprus rotundus* and *Euphorbia hirta* comprising of both monocot and dicot weeds.

Statistical analysis from the pooled data showed that different treatments significantly affected the weed density m⁻² in garlic crop [Fig-1]. It was noted that maximum weed density was found in Control (weedy check). The weed population was minimum in the plots treated with Pendimethalin 30% EC followed by one hand weeding at 45 days after sowing (3 at 45 DAS, 4.17 at 60 DAS and 8.50 at harvest 4). Similarly, weed population in Pendimethalin 30% EC twice was also statistically at par. Pendimethalin has been reported as effective herbicide in garlic crop [14, 15].

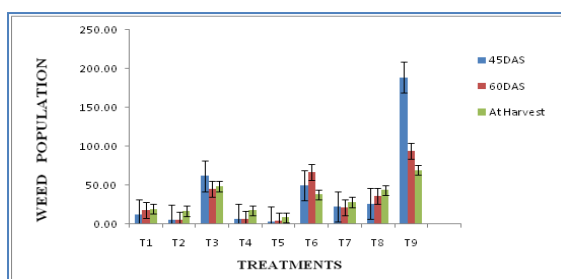


Fig-1 Weed population

T1: Oxyfluorfen twice,

T6: Quizalofop Ethyl + hand weeding

T2: Pendimethalin twice

T3: Quizalofop Ethyl twice

T4: Oxyfluorfen + hand weeding

T5: Pendimethalin + hand weeding

T7: Quizalofop Ethyl + Oxyfluorfen

T8: Pendimethalin + Quizalofop Ethyl

T9: Weedy check (Control).

Control Efficiency (WCE%)

Weed control efficiency was significantly affected by different treatments of weed management practices. The highest weed control efficiency [Fig-2] was found in the plots treated with Pendimethalin followed by one HW at 45 DAS (98.43 %, 95.87, 88% in 45 DAS, 60 DAS and in harvest) T2 came second with a weed control efficiency (97.01%, 95.16, 76.52% in 45 DAS, 60 DAS and in harvest). Weed control efficiency was lowest in T3 (67.30%, 51.82% and 30.29 in 45 DAS, 60 DAS and in harvest). The integrated treatment of Pendimethalin and hand weeding at 45 DAS (T5) recorded significantly lower weed population and dry weight than the control. This may be attributed to initial checking of weed growth by Pendimethalin and hand weeding at 45 DAS, further resulted less crop weed competition which reflected in lower weed population. Superiority of Pendimethalin has been reported by several researchers in multiple clove garlic [9, 7, 6].

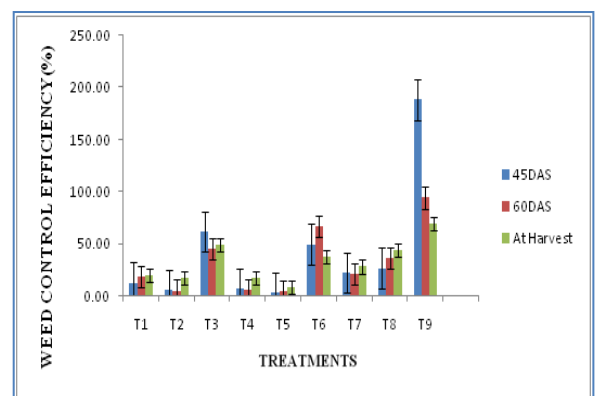


Fig-2 Weed control efficiency (%)

Fresh and dry Weed Biomass (g m⁻²)

The data presented in [Fig-3 and 4] revealed the variation of total fresh and dry weight of weeds obtained under each treatment over the two year (2013-2015). In case of fresh and dry weight the treatment T5: pendimethalin followed by one HW at 45 DAS (3.31 g/m² and 0.88 g/m² respectively in 45 DAS) and (2.23 g/m² and 1.47 g/m² respectively in 60 DAS) and (4.50 g/m² and 2.91 g/m² respectively at harvest) was the lowest followed by T2: pendimethalin 30% EC (Stomp) applied before sowing and second at 60 DAS, (3.33 g/m² and 1.70 g/m² respectively at 45 DAS) and (2.27 g/m² and 1.84 g/m² respectively in 60 DAS) and (8.48 g/m² and 3.59 g/m² respectively at harvest).

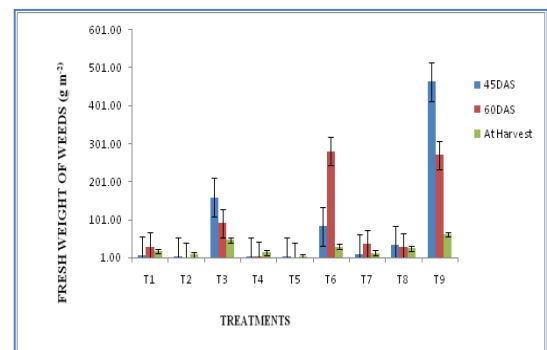


Fig-3 Fresh weed biomass (g m⁻²)

T1: Oxyfluorfen twice,

T2: Pendimethalin twice

T3: Quizalofop Ethyl twice

T4: Oxyfluorfen + hand weeding

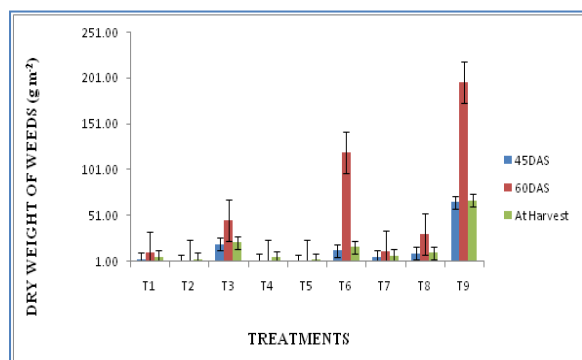
T5: Pendimethalin + hand weeding

T6: Quizalofop Ethyl + hand weeding

T7: Quizalofop Ethyl + Oxyfluorfen

T8: Pendimethalin + Quizalofop Ethyl

T9: Weedy check (Control).

Fig-4 Dry weed biomass (g m⁻²)

T1: Oxyfluorfen twice,
T2: Pendimethalin twice
T3: Quizalofop Ethyl twice
T4: Oxyfluorfen+ hand weeding
T5: Pendimethalin + hand weeding

T6: Quizalofop Ethyl + hand weeding
T7: Quizalofop Ethyl + Oxyfluorfen
T8: Pendimethalin + Quizalofop Ethyl
T9: Weedy check (Control).

Highest fresh and dry weight of weeds obtained in control plot T9 (464.48 g/m² and 65.40 g/m² respectively at 45 DAS) and (270.95 g/m² and 196.40 g/m² at 60 DAS) and (62.43 g/m² and 67.77 g/m² respectively at harvest).

Data from total dry weight of weeds clearly revealed that T5 produced the lowest dry weight of weeds followed by T2. In control total dry weight is clearly high. This confirms that these treatments significantly reduced the dry weight of weeds over the control. T5 gave the lowest dry weight as the weeds population was also less there due to the combination of hand weeding and herbicides. This confirms that Pendimethalin was able to control the population of weed flora more efficiently than other treatments. Similar observations were also communicated in multiple clove garlic by [16, 14].

Bulb parameters:

[Fig-5] shows that average bulb weight (g), average bulb diameter (cm), average bulb length (cm) and clove per bulb were significantly affected by different weed management practices and are highly significant. The results showed that maximum average bulb character i.e. bulb weight, bulb diameter, bulb length and clove per bulb (17.84 g, 3.82 cm, 6.17 cm and 15.16 respectively) was found in plots, which were sprayed with Pendimethalin 30% and one hand weeding 45 DAS. Treatment T5 performed the best because Pendimethalin is able to control all types of weed flora more efficiently than Oxyfluorfen and other herbicides. The un weeded plots produced the lowest bulb weight, bulb width, length and clove/ bulb i.e. (7.52 g, 2.84 cm, 3.63 cm and 5.05 respectively) than all the treatments because it had the highest weed competition caused in unfavourable growing condition for the crop. Similar results were also reported by [17, 14, 15] in multiple clove garlic. The sole application of Pendimethalin before sowing and 60 DAS (T2) gave the second best result in respect of bulb character (15.14 g, 3.62 cm, 5.27 cm and 14.07 respectively).

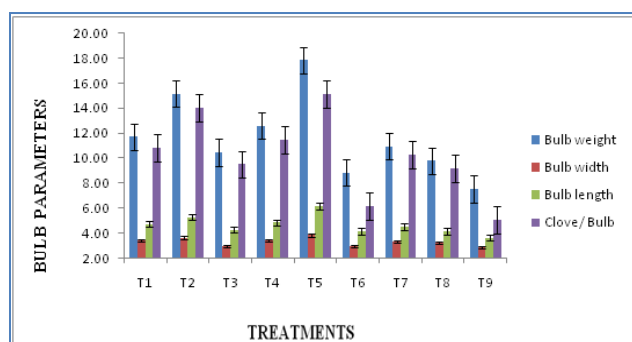


Fig-5 Bulb parameters viz. Bulb weight (g), bulb width (cm), bulb length (cm) and clove/bulb

T1: Oxyfluorfen twice,

T6: Quizalofop Ethyl + hand weeding

T2: Pendimethalin twice
T3: Quizalofop Ethyl twice
T4: Oxyfluorfen+ hand weeding
T5: Pendimethalin + hand weeding

T7: Quizalofop Ethyl + Oxyfluorfen
T8: Pendimethalin + Quizalofop Ethyl
T9: Weedy check (Control).

Total and Projected yield (t/ha):

Bulb yield of garlic was significantly affected by weed control treatments in both years [Fig-6]. The results displayed that the highest yield (total yield as well as projected yield 5.45t/ ha and 4.63 t/ ha respectively) was recorded in plots, which were sprayed with Pendimethalin 30% and one hand weeding 45 DAS followed by the sole application of Pendimethalin before sowing and 60 DAS (T2) (total yield 5.26t/ ha and projected yield 4.47 t/ ha). The control plot recorded total yield as well as projected yield of 2.89 t/ ha and 2.45t/ ha respectively which was 46% and 47% lower than the best treatment (T5). [3, 4] showed that weed reduced the garlic bulb yield (multiple clove) 30 - 60% over the best treatment (Pendimethalin and hand weeding).

Combination of Pendimethalin and hand weeding was found to be more effective herbicides to control weeds for suppressing different weed flora from field. Hence the treatment recorded highest bulb yield than other treatment.

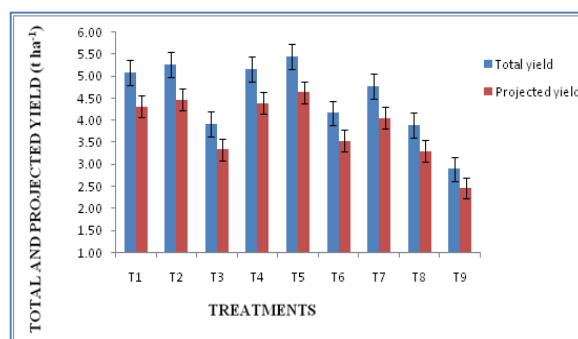


Fig-6 Total and projected yield (t/ha)

T1: Oxyfluorfen twice,
T2: Pendimethalin twice
T3: Quizalofop Ethyl twice
T4: Oxyfluorfen+ hand weeding
T5: Pendimethalin + hand weeding

T6: Quizalofop Ethyl + hand weeding
T7: Quizalofop Ethyl + Oxyfluorfen
T8: Pendimethalin + Quizalofop Ethyl
T9: Weedy check (Control).

Quality parameter of garlic as influenced by herbicides

The data regarding TSS, Vit C and RSA% revealed that the effect of different herbicides was non-significant [Fig-7]. Pendimethalin 30% and one hand weeding 45 DAS (T5) recorded the highest TSS, Vit C and RSA % properties in garlic (23.58°Brix, 17.30 mg/100 g and 87.22 % respectively) followed by pendimethalin before sowing and 60 DAS (T2) (23.58°Brix, 17.30 mg/ 100g and 87.19 % respectively). The lowest TSS, Vit C and antioxidant were found in control (20.67°Brix, 15.67 mg/100g and 37.03%). This is because Pendimethalin was able to control all type of weed flora more efficiently than other herbicides.

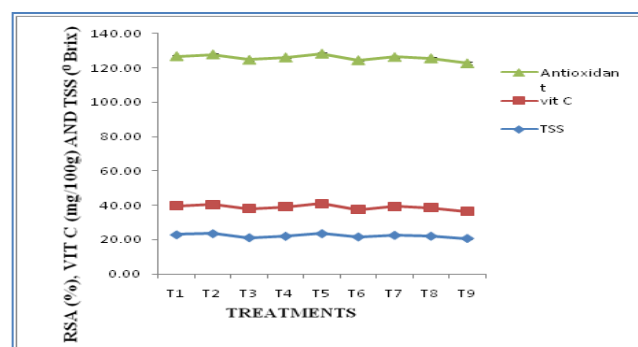


Fig-7 Quality parameters viz. Antioxidant, RSA %, Vit C (mg/100g) and TSS° Brix)

T1: Oxyfluorfen twice,
T2: Pendimethalin twice
T3 : Quizalofop Ethyl twice
T4: Oxyfluorfen+ hand weeding
T5: Pendimethalin + hand weeding
T6: Quizalofop Ethyl + hand weeding
T7: Quizalofop Ethyl + Oxyfluorfen
T8 :Pendimethalin + Quizalofop Ethyl
T9: Weedy check (Control).

pH: Potential of hydrogen
RBD: Randomized block design
g: gram
m: meter
mg: milligram
cm: Centimeter
kg: Kilo gram
ha: hectare
%: percentage
t: tonnes

Loss of weight during storage

The initial weight of garlic in each treatment was 100 g. The bulbs during storage lost their weight periodically with time upto the 8th week. There was a gradual loss of weight in a constant manner [Fig-8]. In case of shelf life, minimum weight loss was found in garlic treated with pendimethalin and one hand weeding 45 DAS (1st week 87.88, 2nd week 73.21g, 3rd week 64.21 g, 4th week 56.55 g, 5th week 50.05g, 6th week 45.86 g, 7th week 42.36 g, 8th week 39.48 g) and maximum weight loss is found in control plot (1st week 77.12 g, 2nd week 62.45g, 3rd week 53.45g, 4th week 45.79g, 5th week 39.29g, 6th week 35.10g, 7th week 31.60g, 8th week 28.72g). [18] found that at room temperature the storage life of garlic is one or two month in multiple clove (during curing).

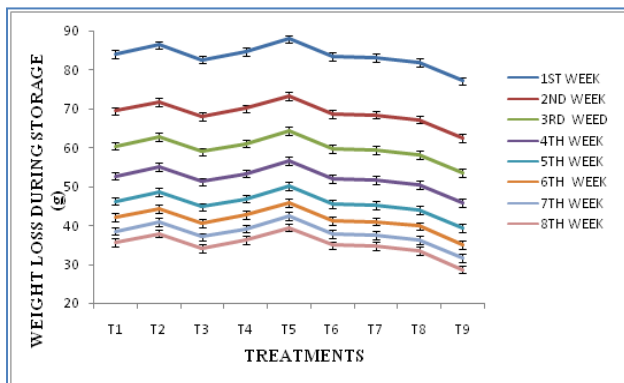


Fig-8 Weight loss during storage

T1: Oxyfluorfen twice,
T2: Pendimethalin twice
T3 : Quizalofop Ethyl twice
T4: Oxyfluorfen+ hand weeding
T5: Pendimethalin + hand weeding
T6: Quizalofop Ethyl + hand weeding
T7: Quizalofop Ethyl + Oxyfluorfen
T8 :Pendimethalin + Quizalofop Ethyl
T9: Weedy check (Control).

Conclusion

It may be concluded that yield maximization, quality enhancement and storage point of view (Pendimethalin 30% EC (Stomp) applied before sowing + one hand weeding at 45days after sowing) may be suggested as the most effective weed management option in the Alluvial zone of West Bengal.

Acknowledgement / Funding:

It is a part of MSc Thesis of the first author and fund for this research work received from Bidhan Chandra Krishi Viswavidyalaya has been duly acknowledged.

Author Contributions:

Mallik, S: Execution of the whole work, day to day monitoring, recording primary and secondary data, lab work.
Sharangi, A.B: Design of the experiment, interpretation and calculation of data.
Datta, N.: Assisted in quality estimation.

Abbreviations:

HRS: Horticultural Research Station
EC: Emulsifiable concentrate
DAS: Days after sowing
HW: Hand weeding
WCE: Weed control efficiency
TSS: Total soluble solid
RSA: Radical scavenging activity

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.

Conflict of Interest: None declared

References

- [1] Pandey U.B. (1997) Garlic cultivation in India, Tech. Bule No. 7, NHRDF, Nasik.
- [2] Chung L. Y. (2006) *J Med Food.*, 9(2), 205-213.
- [3] Baloch A. F. (1994) Vegetable Crops. In "Horticulture". Edited by Elena Bashir and Robeyn Bantel. National Book Foundation, Islamabad Pakistan., pp. 502-503.
- [4] Lawande K.E., Khar A., Mahajan V., Srinivas P.S., Sankar V. and Singh R.P. (2009) *Journal of Horticultural Sciences*, 4(2), 91-119.
- [5] Rahman U.H., Khattak A.M., Sadiq M., Ullah K., Javeria S. and Ullah I. (2012) *Sarhad Journal of Agriculture*, 28(2), 213-218.
- [6] Mahmood T., Khokhar K.M., Hussain S.I. and Laghari M.H. (2002) *Asian Journal of Plant science*, 1(4), 412-413.
- [7] Vora V.D. and Mehta D.R. (1999) *Agric. Sci. Digest Karnal*, 19, 129-133.
- [8] Qasem J.R. (1996) *Crop protection*, 15(1), 21-26.
- [9] Vora V.D. and Mehta D.R. (1998). Integrated weed management in winter garlic. *Agric. Sci. Digest Karnal*, 18, 237-39.
- [10] Mahmood T., Khokhar K.M. and Shakeel M. (2007) *Crop protection*, 26, 1031-1035.
- [11] Khan M.A., Hassan G., Shah W.A. and Afridi M.Z. (2002) *Sarhad J. Agric*, 18(3), 335-337.
- [12] Uaman K., Khalil S. K. and Khan M. A. (2010) *Sarhad J. Agric.*, 68, 281-283.
- [13] AOAC (1984) Official Method of Analysis. 14 th edition (S. Williams, ed.), pp. 844-846.
- [14] Vashi J. M., Patel N. K. and Desai D. T. (2011) *Vegetable Science*, 38(1), 119-120.
- [15] Patel T. U., Thanki J. D., Patel D. D., Arvadiya L. K. and Italiya A.P. (2013) *BIOINFOLET*, 10 (2A), 379 - 381.
- [16] Zubair M., Rahman H. U. and Jilani M. S. (2009) *Pak J. Weed Sci. Res*, 15(1), 45-51.
- [17] Kumar S., Rana S.S., Chander N. and Sharma N. (2013) *Indian Journal of Weed Science*, 45(2), 126-130.
- [18] Kumar R.K.C. and Sung J. (2010) *Horticulture NCHU*, 33(3), 81-93.