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Research Article

PERFORMANCE OF GARLIC (*ALLIUM SATIVUM* L) GENOTYPES AFTER TRANSPLANT AMAN RICE HARVEST UNDER ZERO TILLAGE MULCHED CONDITION

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Abstract

The selected garlic varieties/lines viz., BARI Roshun-1, BARI Roshun-2, GC0018, GC0024, GC0027, GC0034 and one local cultivar were evaluated under zero tillage mulched condition to find out the suitable varieties/lines. There were significant differences among genotypes for all studied characters except number of leaves per plant. The advanced lines GC0018, GC0027 and GC0034 were graded as the highest bulb yield and it was more than 10 t/ha. But numerically the highest bulb yield (10.89 t/ha) was produced in GC0034 line while the local variety produced only 6.82 t/ha. GC0027 genotype was produce the longest plant (60.53 cm) and largest bulb diameter (3.94 cm), while local cultivar was the minimum. Simple correlation analysis showed that there were positive and significant correlation among bulb yields with all the parameters except plant height and leaves per plant. Highest water use efficiency 44.63 kg ha^{-1} mm^{-1} was obtained from GC0034 line. In respect of monetary return GC0034 produced the maximum gross return (Tk. 653400/ha), gross margin (Tk. 515125/ha) and benefit cost ratio (4.73). The finding of this study could be useful for improving garlic production after transplant aman rice harvest under zero tillage mulched condition.

Key words: Garlic; zero tillage; mulched condition; correlation

Introduction

Garlic (*Allium sativum* L) is a most important spices crop grown in Bangladesh. It is generally cultivated through conventional tillage of land preparation. In many areas farmers cultivate garlic after harvest of T-aman rice. But it takes few to more days for land preparation which causes late planting of garlic resulting reduced the bulb yield. Brewster (1994) reported that late sown garlic plants switched from leaf blade to bulb formation. Consequently, the leaf area index and the interception of light by crop canopy become much lower than that of early sown plants, which subsequently become reflect in low yield. To reduce the turn around time, it can be cultivated under zero tillage (dibbling) mulched condition after T-aman rice harvest especially in low land or flood affected area of Bangladesh. At present, garlic production under zero tillage mulched condition is a common practice at 'Chalan beel' area of Gurudaspur Natore, Rajsahi, Bangladesh. In this system, after receding flood water farmers produce garlic in the wet land. They harvest T-aman rice with a little plant parts; use most of the straw for mulching in garlic. They generally use no/zero tillage. They just dibble the cloves in the muddy soil and then give thick mulch by the rice straw. About 16905 ha of land remains under zero tillage mulched cultivation in Natore and Pabna districts of Bangladesh which was 40% of total garlic production in Bangladesh (Anon., 2013). Soil moisture conservation is the prime factor for crop cultivation under zero tillage condition. Straw mulching might play a significant role in soil moisture conservation and it suppresses weed growth effectively in garlic (Ibrahim, 1994; Karaye and Yakubu, 2006). Garlic is sensitive to moisture stress and high temperature and about 60% reduction in yield has been associated with water stress (Miko *et al.*, 2000; Bello, 2001). Many reasons have occurred that responsible for low yield of garlic. Variety is one of them. Many investigators studied the growth and yield variations among garlic genotypes (Islam *et al.*, 2004; Dawood *et al.*, 2011; Gouda Anwar, E.A.I., 2012; Waterer, D. and D. Schmitz, 1994). The farmers are generally cultivated local variety of garlic namely Italian, Amoni, Aushy. The average yield of these varieties are very low (4-5 t/ha). Spices Research centre, BARI has developed two garlic verities namely BARI Roshun-1, BARI Roshun-2 and some advanced lines like GC0018, GC0024, GC0027 and GC0034 which are higher yielder than local varieties. Gvozdanovic-Varga *et al.*, (2002) reported that garlic does not produce seed, breeders cannot breed and develop cultivars specific to growing regions. So, selection and planted the domestic accessions/landraces, which are fully adapted to local

conditions and are important genetic resources and initial breeding material. Moreover, there was no recommended garlic variety under zero tillage mulched cultivation. Considering the above facts, the trial may be undertaken to find out the superior variety/lines under zero tillage mulched condition.

Materials and Methods

The experiment was conducted at the Regional Agricultural Research Station, Bangladesh Agricultural Research Institute, Ishurdi, Pabna during the rabi season of 2012-2013 and 2013-2014 to find out the superior variety/lines under zero tillage mulched condition. The climate of the experimental site was subtropical in nature and it's belongs to the Agro-ecological Zone-11 (AEZ-11) in Bangladesh. The latitude and longitude of the experimental site is 24.03^0 S and 89.05^0 E, respectively. The land was medium high and the soil was clay loam in texture having 7.22 p^H, 1.05% organic matter, 0.056% total nitrogen, 11µg/ml available phosphorus, 0.12 meq/100g soil available potassium, 13 µg/ml sulphur, 0.20 µg/ml boron and 1.9 µg/ml zinc. The initial soil moisture was 40.14% and 40.26% in both the years, respectively. Field capacity and bulk density of the soil were 28% and 1.40 g/cc respectively; permanent wilting point was near about 14%. The experiment was laid out in a RCB design with three replications. Seven garlic genotypes namely BARI Roshun-1, BARI Roshun-2, GC0018, GC0024, GC0027, GC0034 advanced lines and one local cultivar were evaluated in the study. The unit plot size was 3m x 3m. The clove was planted in line by dibbling maintaining 15 cm ×10 cm plant spacing on the muddy soil just 2 to 3 days after harvesting T-aman rice. Then the muddy soil surface was covered with rice straw at the rate of 6 t/ha. T-Aman rice was harvested at a stalk height of 2-3 cm for garlic production under zero tillage condition. Planting was done manually using one clove per hole. The crop was fertilized with 155-35-125-30-2-1 kg N-P-K-S-Zn-B/ha. One third nitrogen was applied as basal and two third was top dressed in two equal installments at 25 and 50 days after emergence. Other fertilizers were applied on the muddy soil as basal before planting and covering the soil surface by rice straw. Two hand weeding was done at 25 and 50 days after emergence. Irrigation was done by PVC pipe up to field capacity at 50 and 75 days after planting to investigate the soil moisture level. Soil sample were collected from the depth of soil profile section viz; (0-15, 15-30 and 30-40 cm) with help of sampling tube and moisture was calculated by oven dry method, thermostatically controlled oven maintained at a temperature of 110 ± 5°C for 24 hours. The effective root zone depth of garlic 40 cm. Effective rainfalls was recorded 17 mm and 35 mm in both the year, respectively. The crop was planted on 11 November 2012 and 12 November 2013 and harvested on 2-8 April, 2013 and 2014, respectively. Soil moisture level at ten days interval on an average of two years is depicted in Fig. 1. Water use efficiency (WUE) has been expressed as the ratio of bulb yield to the total water use of garlic (Stanhill, 1987). Data on yield and yield components were recorded and analyzed statistically. The mean values were adjusted by LSD at 0.05 levels of probability.

Results and Discussion

Effect of garlic genotypes on bulb yield and yield contributing characters

The significant differences were recorded among garlic genotype for all studied characters except number of leaves per/plant (Table 1). Days to maturity showed significant variations among the garlic genotypes and which was ranged from 137-142 days. GC0034 advanced line required maximum period (142 days) for maturity which was followed by GC0018 line (141 days). The local cultivar took minimum period (137 days) for maturity. This was followed by BARI Roshun-1 (139 days) and BARI Roshun-2 (139 days). Maximum plant height (60.53 cm) was recorded in the line GC0027 which was followed by BARI Roshun-2 (58.28 cm) and minimum in local cultivar (Table 1). The highest individual bulb weight was in GC0034 (28.79 g) followed by GC0027 (27.86 g) and was significantly higher than those in all other garlic genotypes. The local cultivar produced the minimum individual bulb weight (19.46 g) among the genotypes. This is an indication of high yield potential of GC0034 and GC0027. Similar trend was observed in case of number of clove/bulb and 100-clove weight. In case of bulb diameter, all the genotypes were significantly different from each other at 5% level. The maximum bulb diameter was found in GC0027 line (3.94 cm) which was followed by GC0034 line (3.84 cm). The minimum bulb diameter (3.16 cm) was observed in local cultivar. GC0034 line had the highest value for neck bulb diameter (0.89 mm) followed by GC0018 line (0.84 mm), while Local cultivar had the lowest value for this character.

The advanced lines GC0018, GC0027 and GC0034 were graded as the highest bulb yield and it was more than 10 t/ha. But numerically the highest bulb yield (10.89 t/ha) was produced in GC0034 line, which was followed by GC0027 line (10.58 t/ha). Both were significantly different from the remaining varieties/lines (Table 2). The higher bulb yield of GC0034 and GC0027 were attributed to maximum individual bulb weight, number of clove/bulb and 100-clove weight. So, if we introduced these genotypes to farmers, they will benefited economically by getting higher bulb yield. Alam *et al.,* (2010) reported that in wet land conditions, garlic produce very well by the simple management. He also mention that the farmers used local cultivar namely Italian, Amoni, aushy which received from local source and got 3-6 t/ha yield and few farmers got 7-8 t/ha yield. The result of this study observes that variations among these genotypes clearly in all the studied characters. This variation might be due to genetic differences among the genotypes.

Table 1: Days to maturity, Plant height, Number of leaves/plant, Individual bulb weight and Number of clove/ bulb of garlic under zero tillage mulched condition (pooled data of 2012-13 and 2013-14)

Treatments	Days to maturity (days)	Plant height (cm)	No. of leaves/plant	Individual bulb weight (g)	Number of clove/ bulb (no.)
BARI Roshun-1	139	57.20	6.73	21.74	23.24
BARI Roshun-2	139	58.28	6.92	22.29	24.57
GC0018	141	53.58	7.25	23.76	24.04
GC0024	140	56.78	6.78	22.33	24.41
GC0027	140	60.53	6.92	27.86	27.61
GC0034	142	54.14	7.42	28.79	28.90
Local	137	52.18	6.92	19.46	20.63
LSD(0.05)	2.41	2.49	NS	1.29	1.49
CV (%)	1.44	3.72	6.64	4.58	5.06

Table 2: 100-clove weight, Bulb diameter, Neck diameter and Bulb yield of garlic under zero tillage mulched condition (pooled data of 2012-13 and 2013-14)

Treatments	100-clove weight (g)	Bulb diameter (cm)	Neck diameter (mm)	Bulb yield (t ha^{-1})
BARI Roshun-1	101.02	3.54	0.75	7.65
BARI Roshun-2	103.55	3.58	0.74	8.33
GC0018	106.06	3.65	0.84	10.36
GC0024	103.87	3.60	0.78	8.95
GC0027	108.85	3.94	0.82	10.58
GC0034	110.71	3.84	0.89	10.89
Local	98.87	3.16	0.73	6.82
LSD(0.05)	2.70	0.26	0.07	0.69
CV (%)	2.17	6.11	7.11	6.41

Table 3: Correlation among the characters studied in garlic under zero tillage mulched condition

	PH	LPP	IBW	CPB	HCW	BD	ND	BY
DM	0.07	0.69	0.81**	0.82**	0.89**	0.82**	0.92**	0.91**
PH		-0.48	0.31	0.42	0.26	0.58	-0.11	0.20
LPP			0.61	0.52	0.68	0.37	0.83**	0.68
IBW				0.97**	0.97**	0.92**	0.87**	0.91**
CPB					0.96**	0.94**	0.8**	0.87**
HCW						0.92**	0.91**	0.97**
BD							0.75*	0.89**
ND								0.93**

*Significant at 5% level, **Significant at 1% level.
PH= Plant height, LPP= Leaves per plant, IBW= Individual bulb weight, CPB= Clove per bulb, HCW= Hundred clove weight, BD= Bulb diameter, ND= Neck diameter and BY= Bulb yield.

Correlation of plant characters among the garlic genotypes

Correlation coefficient among various characters was presented in Table 3. Yield/ha showed significant positive correlation almost all other characters except plant height (r=0.20) and leaves/plant (r=0.68). Days to maturity showed a positive and significant relationship with individual bulb weight (0.81**), cloves/bulb (0.82**), 100-clove weight (0.89**), bulb diameter (0.82**) and neck diameter (0.92**). Neck diameter also exhibit significant positive association with all other parameters while it showed negative correlation with plant height. Bulb diameter has a significant positive correlation with all the characters whereas insignificant positive correlation showed with plant height and leaves/plant which could be the factor for selection to improve the yield. Individual bulb weight, have significant and positive correlation with cloves/bulb (0.97**), 100-clove weight (0.97**), bulb and neck diameter (0.92** and 0.87**) and bulb yield (0.91**) and these characters may be used as traits for selection to improve the yield of garlic. The findings are in conformity with the findings of Figliuolo *et al*., 2001 and Shri Dhar, 2002. Clove/bulb and hundred clove weight showed positive significant correlation with most of the traits except for plant height and leaves/plant which showed positive

insignificant correlation. Leaves/plant exhibit a negative insignificant correlation with plant height. Between plant height and neck diameter there is negative association was found.

Soil moisture level

Fig. 1 presented soil moisture level at ten days interval during the growing seasons of all genotypes. The figure showed that moisture content was above field capacity up to 30 days after emergence. Soil moisture varies 24.33% to 27.50% at 40 DAE to 90 DAE and gradually decreased during the rest growing period. Finally at harvest period soil moisture was around 15% which above the wilting point. Two irrigations were applied at 50 and 75 DAE; irrigation water was applied up to field capacity at each irrigation. These result also indicated that all the genotypes of garlic used soil moisture until the moisture level was gone to the permanent wilting point.

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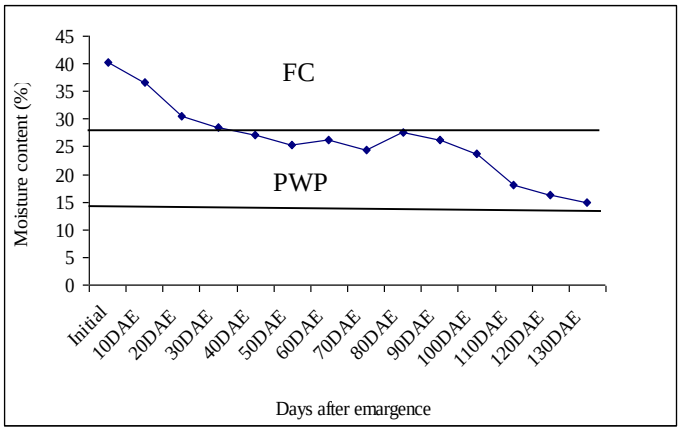

Fig.1: Soil moisture level at ten days interval on an average of two years [FC= Field capacity, PWP= Permanent wilting point]

Water use efficiency (WUE)

Yield of different garlic genotypes varies 6.82 t/ha to 10.89 t/ha with used about 244 mm of seasonal water. The water use efficiency varied from 27.95 to 44.63 kg ha^{-1} mm^{-1} depending on garlic genotypes (Fig.2). The highest water use efficiency (44.63 kg $ha^{-1}mm^{-1}$) was observed with GC0034 line followed by GC0027 (43.36 kg $ha^{-1}mm^{-1}$). The lowest was in local cultivar (27.95 kg $ha^{-1}mm^{-1}$).

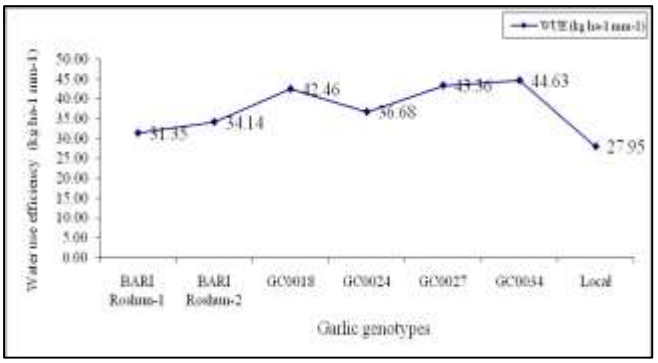

Fig.2: Water use efficiency of garlic genotypes on an average of two years

Cost benefit analysis

Maximum gross return (Tk. 653400/ha) was observed from the genotype GC0034 which might be due to its higher bulb yield followed by GC0027 (Tk. 634800/ha). The minimum gross return (Tk. 409200/ha) was found from local cultivar. Maximum gross margin (Tk. 515125/ha) and benefit cost ratio (4.73) were also found in GC0034 followed by GC0027. The lowest gross margin (Tk. 270925/ha) and benefit cost ratio (2.96) were recorded in local cultivar might be due to lower bulb yield (Table 4).

Conclusion

In respect of bulb yield, garlic lines GC0018, GC0027 and GC0034 perform better under zero tillage mulched condition compared to BARI Roshun-1, BARI Roshun-2, GC0024 and local cultivar. Among them GC0034 gave the highest bulb yield (10.89 t/ha) followed by GC0027 (10.58 t/ha). The genotype GC0027 had the highest plant height (60.53 cm) and bulb diameter (3.94 cm). On the basis of gross return, gross margin, benefit cost ratio and water use efficiency GC0034 line performed better than any other genotypes. Finally, it may be concluded that garlic can be cultivated after transplant aman rice harvest under zero tillage mulched condition simultaneously conventional tillage method of cultivation.

Table 4: Cost benefit analysis of garlic under zero tillage mulched condition (pooled data of 2012-13 and 2013-14)

Treatments	Gross return (Tk/ha)	Variable cost (Tk/ha)	Gross margin (Tk/ha)	BCR
BARI Roshun 1	459000	138275	320725	3.32
BARI Roshun 2	499800	138275	361525	3.61
GC0018	621600	138275	483325	4.50
GC0024	537000	138275	398725	3.88
GC0027	634800	138275	496525	4.59
GC0034	653400	138275	515125	4.73
Local	409200	138275	270925	2.96

*Price of harvested Garlic bulb @ 60000/= per ton, BCR = Gross return ÷ variable cost

References

Alam MS, Rahim MA. and Simon PW (2010) Standardization of production technology for garlic under dry and wet land conditions. J. Agrofor. Environ. 3 (2):5-8.

Anonymous (2013) Regional extension research report on the Department of Agricultural Extension, Natore. Annual review workshop 2013 held at Regional Agricultural Research Station, BARI, Ishurdi, Pabna, p.1.

Bello K (2001) Effect of irrigation frequency and weeding regimes on growth and yield of garlic (*Allium sativum* L.). Unpublished B.Sc. Project, Crop Science Department, UDU Sokoto.

Brewster JL (1994) Weed competition and bulb yield of garlic. Onion and Other Vegetable Alliums. No. 3 Warwick USA. p. 406.

Dawood AR, Abd El-Aal SA, Badawey AS and Attallah SY (2011) Testing of some garlic (*Allium sativum* L.) cultivars under Assiut conditions. Assiut J. Agricultural Sciences, 42(2): 378-390.

Figliuolo G, candido V, Logozzo G and Zeuli PLS (2001) Genetic evaluation of cultivated garlic germplasm. Euphytica, 121: 325-34.

Gouda Anwar EAI (2012) Evaluation of Some Garlic (Allium sativum L.) Cultivars Grown Under Mansoura Region Conditions. Research Journal of Agriculture and Biological Sciences, 8(5): 407- 410.

Gvozdanovic-Varga J, Vasic M and Cervenski J (2002) Varialbility of characteristics of Garlic (*Allium sativum* L.) ecotypes. Acta Hort., (ISHS), 579: 171-175.

Ibrahim Al (1994) Effect of grass mulch and plant spacing on growth and yield of garlic (*Allium sativum* L.) Unpublished B.Sc. project, Dept. Agron. ABU Zaria.

Islam MJ, Islam MA, Tania SA, Saha SR, Alam MS and Hasan MK (2004) Performance evaluation of some Garlic genotypes in Bangladesh. Asian Journal of Plant Sciences, 3(1): 14-16

Karaye AK and Yakubu AI (2006) Influence of intra−row spacing and mulching on weed growth and bulb yield of garlic (*Allium sativum* l.) in Sokoto, Nigeria. *Afr. J. Biotechnol.* 5 (3):260−264.

Miko S, Ahmed MK, Amans EB, Falaki AM and llyas N (2000) Effects of levels of nitrogen, phosphorus and irrigation interval, on the performance and quality of garlic (*Allium sativum* L). *J. Agric. Environ*. vol.1, No. 2.

Shri Dhar (2002) Genetic variability and character association in garlic. Progressive Horticulture, 34: 88-91.

Stanhill G (1987) Water use efficiency. Adv. Agron., 39: 53-85.

Waterer D and Schmitz D (1994) Influence of variety and cultural practices on garlic yields in Saskatchewan. Can. J. Plant Sci., 74: 611-614.