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Abstract

A experiment was conducted at Agronomy field of Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur and Regional Agricultural Research Station, Jessore during rabi season of 2017-18 to find out the optimum dose of herbicide and to know the weed control efficiency. The treatments were T_1=Pendistar 33 EC @ 1.0 L/ha spraying at 3-4 DAT, T_2=Pendistar 33 EC @ 1.5 L/ha spraying at 3-4 DAT, T_3= Pendistar 33 EC @ 2.0 L/ha spraying at 3-4 DAT, T_4=Pendistar 33 EC @ 2. 5 L/ha spraying at 3-4 DAT, T_5= Pendistar 33 EC @ 3.0 L/ha spraying at 3-4 DAT, T_6= Weed free (two hand weeding), T_7=No Weeding (Control). Among the different doses of herbicide Pendistar 33 EC @ 2.0 L/ha spraying at 3-4 DAT, showed the best results in controlling different types of weedst. Plant height, single bulb weight and bulb yield of onion were significantly influenced by different doses of Panida 33EC herbicide. The highest single bulb weight (85.96 and 85.73 g) and bulb yield (5.33 and 6.06 t/ha) was obtained from T_6 at Gazipur and Jessore which was statistically similar with T_3 where single bulb weight (85.73 g) and yield (5.13 t/ha) was obtained at Gazipur and single bulb weight (83.01 g) and yield (5.63 t/ha) at Jessore. The highest gross margin (Tk.49500 /ha at Gazipur and Tk.59400/ha at Jessore) was noticed in T_3 due to lower cost involvement as compared to T_6. Higher BCR was calculated in T_3 (1.93 at Gazipur and 2.12 at Jessore. Treatment T_6 failed to produce higher gross margin and BCR due to higher cost involvement in T_6 for more number of weeding. The result revealed that two hand weeding would be the best option for getting maximum yield of Onion. Among herbicidal weed control, spraying of Pendistar 33 EC @ 2.0 L/ha spraying at 3-4 DAT might be economically profitable for controlling weeds in onion field.

Key words: Herbicide, Onion field, weed.

Introduction

Onion (*Allium cepa* L.) belongs to the family Alliaceae and it is one the most important spices in Bangladesh. It was introduced into the Asian sub-continent from Palestine (Mac Gillivary, 1961). Onion has great economic importance due to its medicinal and dietetic values. It is widely used as condiment, salad and dressing of food. It is widely cultivated during winter season. However, the average yield of this crop in Bangladesh is low due to improper use of fertilizers, inadequate irrigation, poor weed control etc. Weeds deplete crops environment of nutrients, water and light, thus yields of onionis reduced considerably. In addition, weeds cause spread of several diseases and pests. The quality of produce is also reduced by weed infestation (Pandey, 2000). Weed control is one of the most important factors for a successful crop production and therefore the prevention of weed-crop competition at an early stage plays a very important role (Van-Gessel & Renner, 1990). Weeds that grow with crop compete for nutrients, space and solar radition (Nicto *et al.,* 1968) thereby causing poor growth and development of the crops, resulting in yield reduction. The quality of crop is also reduced by weed infestation. Generally, farmers are controlling weeds by hand weeding in several times. It takes more times and labor which leads to more expenses. Hence, the present experiment was done to find out the optimum dose for controlling weed in onion field and to know the weed control efficiency for getting maximum yield.

Materials and Methods

The field experiment was conducted at Agronomy research field of Bangladesh Agricultural Research Institute, Joydebpur, Gazipur and RARS, Jessore (Fig.:1) during the period from January 2018 to April 2018. The treatments were as follows: T_1=Pendistar 33 EC @ 1.0 L/ha spraying at 3-4 DAT, T_2=Pendistar 33 EC @ 1.5 L/ha spraying at 3-4 DAT, T_3= Pendistar 33 EC @ 2.0 L/ha spraying at 3-4 DAT, T_4=Pendistar 33 EC @ 2. 5 L/ha spraying at 3-4 DAT, T_5= Pendistar 33 EC @ 3.0 L/ha spraying at 3-4 DAT, T_6= Weed free (two hand weeding), T_7=No Weeding (Control). The weedicide was sprayed at 24 January, 2018. The variety of onion was Taherpuri and maintaining spacing 20 cm X 10 cm. The design was randomized complete block with three replications. The plot size was 3 m X 3 m. The crop was fertilized with cowdung 5 t/ha and120-39-75-20 kg/ha of NPKS, respectively. Cowdung was applied at the time of land preparation. Half of N, K and full dose of P, S were applied at the time of final land preparation and remaining N and K were applied as top dressed at 25 and 50 days after transplanting

followed by irrigation.. Transplanting date was 20-01-2018. Number and dry weight of weeds were recorded carefully. Weed control efficiency (WCE) was calculated according to following formula: WCE (%) = $\left(\frac{A-B}{A}\right)100$ where A = dry weight of weeds in no weeding plots and B = Dry weight of weeds in treated plots. The crop was harvested on 07April, 2018. Yield and yield contributing characters were recorded and analyzed statistically. Means was adjusted by LSD test at 5% level of significance.

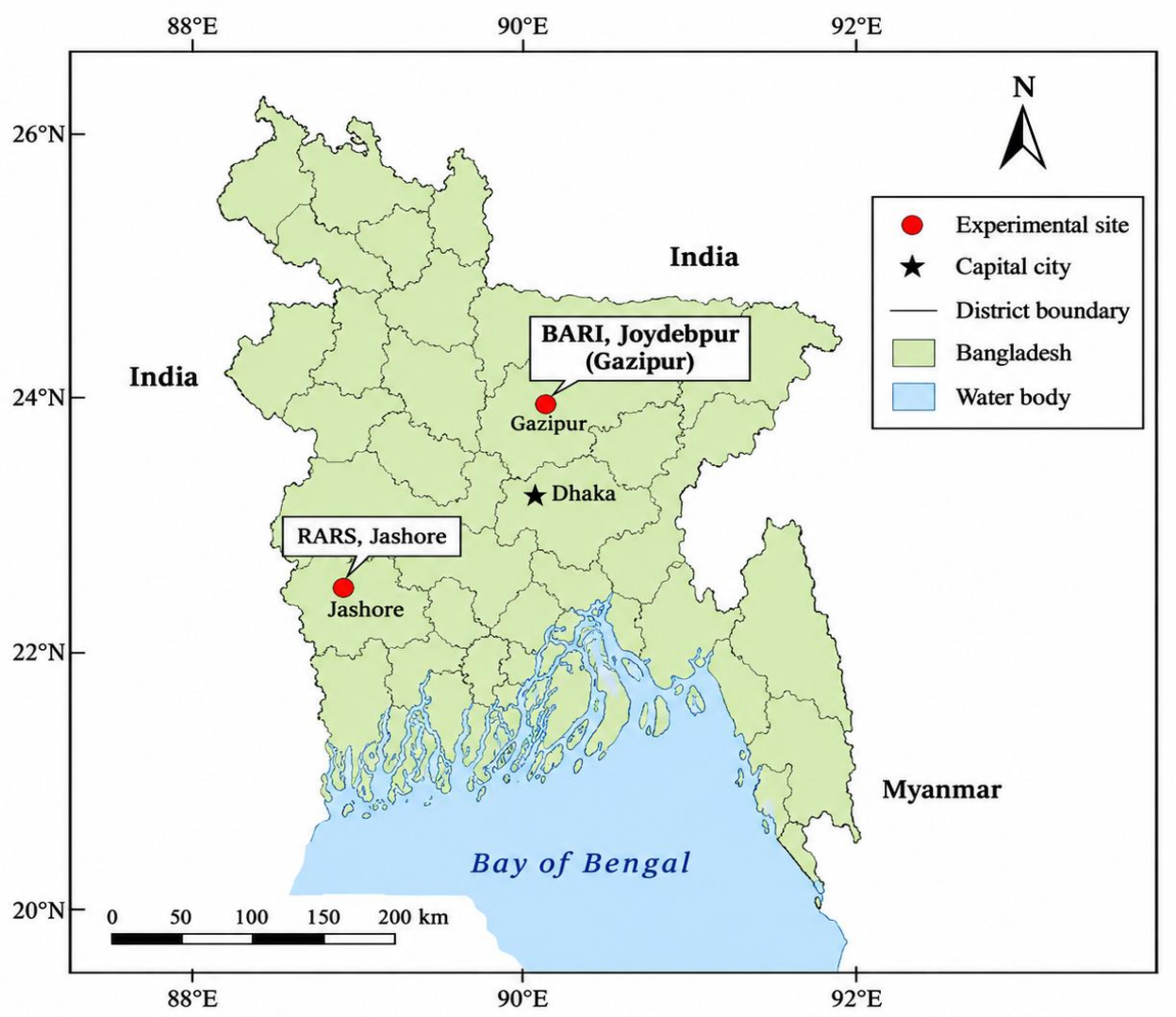


Figure 1. Geographical locations of the experimental sites at Joydebpur, Gazipur and Jashore, Bangladesh, during the Rabi season of 2017–18.

Results and Discussion

Weed flora and dry matter of weeds

Weed species, number of weeds/m^2 and weed density (%) affected by different doses of Pendistar 33 EC herbicide are presented in Table 1, 2 and 3. Shama (*Echinochola crusgali*), Shetlomi (*Gnaphalium affine),*Malancho (*Enhydra fluetuans*) , Bon Palong (*Raphanus rnhanisteaum*)and *Foska Begun* (*Physalis minima)* were the common and dominant weeds in the onion field at Gazipur and Mutha(*Cyperus rotundus),* Durba (*Cynodon dactylon),* Shetlomi (*Gnaphalium affine), and* Shama (*Echinochola crusgali)* were at Jessore. The number of weeds /m^2 ranged from 13 to 70 in different herbicide treated plots at Gazipur and 14 to 78 in different herbicide treated plots at Jessore at 25 DAP . The highest weed /m^2 (70) was recorded in T_7 (control plots) at Gazipur and (78) at Jessore. Shama, Shethlomi, Malancho were found the most dominant weed in onion field ranged from 4 to 65 % at 25 DAE (Table 1) at Gazipur and Mutha, Durba, Sethlomi at Jessore ranged from 3 to 90 % at 25 DAE (Table2). At 50 DAE the number of weeds /m^2 was increased in all the plots than 25 DAE. The maximum weed dry weight of 50.56 and 16.42 g/m^2 at Gazipur and 89.25 and 30.43 g/m^2 at Jessore were obtained in T_7 at 25 DAE and 50 DAE, whereas, the minimum weed dry weight of 4.21 and 2.45 g /m^2 were found in T_6) at Gazipur and 6.57 and 12.56 g /m^2 at Jessore (Table3). The variation in weed control efficiency (WCE) was observed among different herbicides (Table 3). The heighest weed control efficiency was 92% at Gazipur and 72% at Jessore in T_6 treatment.

Yield and yield components of Onion

Plant height, single bulb weight and bulb yield of onion were significantly influenced by different doses of Pendistar 33 EC herbicide. At Gazipur, the highest plant height (46cm), single bulb weight (85.96 g) and yield (5.33 t/ha) were obtained from T_6 treatment which was statistically similar with T_3 where plant height (44 cm), single bulb weight (85.73 g) and bulb yield (5.13 t/ha) but the lowest was in T_7 where plant height (36 cm), single bulb weight (62.06 g) and bulb yield (3.96 t/ha). At RARS, Jessore, highest plant height (47.94 cm), single bulb weight (86.48 g) and bulb yield (6.06 t/ha) were obtained from T_6 treatment which was statistically similar with T_3 where plant height (46.69cm), single bulb weight (83.01 g) and bulb yield (5.63 t/ha) but the lowest was in T_7 where plant height (38.36), single bulb weight (62.67 g) and bulb yield (3.43 t/ha) from Table 4. Treatments T_1, T_2, $T_4$and T_5 gave statistically identical

yield at Gazipur and Jessore. The weed control efficiency of these two treatments T_6 and T_3 were 92and 69% at BARI, Gazipur and at RARS, Jessore, it was 72 and 40%.

Table 1: Effect of different doses of Pendistar 33 EC herbicide on weed species, weed number/m^2 and weed density (%) at 25 DAP and 50 DAP in Agronomy field, BARI, Gazipur during rabi season 2017-18.

Treat	Local name	Scientific name	25 DAP		50 DAP	
			Weed/ m^2 (no.)	Weed density (%)	Weed/m ^{2} (no.)	Weeddensity (%)
T_1=Pendistar 33 EC @ 1.0 L/ha	Bathua	*Chenopodium album*	2	4	4	5
	Shetlomi	*Gnaphalium affine*	8	17	10	14
	Malancho	*Enhydra fluetuans*	6	13	12	16
	Nunia	*Protulaca oleracea*	2	4	5	6
	Shama	*Echinocholacrusgali*	22	47	32	43
	Bon Palong	*Raphanus rnhanisteaum*	4	9	7	10
	Foska Begun	*Physalis minima*	2	4	4	5
		Total	46		74	
T_2= Pendistar 33 EC @ 1.5 L/ha	Shama	*Echinocholacrusgali*	25	65	40	63
	Bon Palong	*Raphanus rnhanisteaum*	3	8	6	10
	Malancho	*Enhydra fluetuans*	5	13	7	11
	Hatishur	*Heliotropium indicum*	3	8	6	10
	Bon Mula	*Raphanus rnhanisteaum*	2	5	4	6
		Total	38		63	
T_3= Pendistar 33 EC @ 2.0 L/ha	Mutha	*Cyperus rotundus*	2	7	4	8
	Durba	*Cynodon dactylon*	2	7	3	6
	Ban mashur	*Vicia sativa*	3	11	5	10
	Malancho	*Enhydr afluetuans*	4	14	10	21
	Shetlomi	*Gnaphalium affine*	4	14	8	17
	Bon Mula	*Raphanusrnhanisteaum*	3	10	4	8
	Shama	*Echinocholacrusgali*	10	36	14	29
		Total	28		48	
T_4= Pendistar 33 EC @ 2. 5 L/ha	Mutha	*Cyperus rotundus*	2	6	4	7
	Malancho	*Enhydrafluetuans*	5	14	10	18
	Bathua	*Chenopodium album*	3	8	6	11
	Shama	*Echinocholacrusgali*	16	44	20	35
	Shetlomi	*Gnaphalium affine*	8	22	12	21
	Bon Palong	*Raphanus rnhanisteaum*	2	6	4	4
		Total	36		56	

$T_{5=}$ Pendistar 33 EC @ 3.0 L/ha	Malancho	*Enhydra fluetuans*	5	14	7	12
	Bon Palong	*Raphanus rnhanisteaum*	2	6	3	5
	Numia	*Protulaca oleracea*	2	6	3	5
	Shama	*Echinochola crusgali*	15	42	35	61
	Ban mashur	*Vicia sativa*	2	6	3	5
	Hatishur	*Heliotropium indicum*	2	6	5	9
	Shetlomi	*Gnaphalium affine*	8	22	13	23
		Total	36		57	
$T_{6=}$Weed free (two hand weeding)	Malancho	*Enhydrafluetuans*	4	31	6	30
	Shama	*Echinochola crusgali*	4	31	7	35
	Shetlomi	*Gnaphalium affine*	3	23	4	20
	Hatishur	*Heliotropium indicum*	2	15	3	15
		Total	13		20	
T_{7}=Control (No Weeding)	Durba	*Cynodon dactylon*	7	10	15	13
	Hatishur	*Heliotropium indicum*	6	9	8	7
	Malancho	*Enhydra fluetuans*	10	14	12	10
	Shama	*Echinochola crusgali*	23	32	38	32
	Mutha	*Cyperus rotundus*	12	17	26	22
	Foska Begun	*Physalis minima*	3	4	6	5
	Bon Mula	*Raphanusrnhanisteaum*	3	4	4	3
	Ban mashur	*Vicia sativa*	6	9	8	7
		Total	70		117	

Table 2: Effect of different doses of Pendistar 33 EC herbicide on weed species, weed number/m^2 and weed density (%) at 25 DAP and 50 DAP at RARS,Jessore during rabi season 2017-18.

Treat	Local name	Scientific name	25 DAP		50 DAP	
			Weed/ m^2 (no.)	Weed density (%)	Weed/m^2 (no.)	Weeddensity (%)
$T_{1=}$Pendistar 33 EC @ 1.0 L/ha	Mutha	*Cyperus rotundus*	46	85	149	93
	Chapra	*Elusine indica*	5	9	6	4
	Malancho	*Enhydra fluetuans*	3	6	4	3
		Total	54		159	

$T_{2=}$ Pendistar 33 EC @ 1.5 L/ha	Mutha	*Cyperus rotundus*	56	90	147	94
	Chapra	*Elusine indica*	4	6	5	3
	Durba	*Cynodon dactylon*	2	3	3	2
		Total	62		155	
$T_{3=}$ Pendistar 33 EC @ 2.0 L/ha	Mutha	*Cyperus rotundus*	32	86	78	91
	Chapra	*Elusine indica*	3	8	4	5
	Malancho	*Enhydra fluetuans*	2	5	3	4
		Total	37		85	
$T_{4=}$ Pendistar 33 EC @ 2. 5 L/ha	Mutha	*Cyperus rotundus*	50	86	106	91
	Chapra	*Elusine indica*	5	9	6	5
	Malancho	*Enhydra fluetuans*	3	5	4	3
		Total	58		116	
$T_{5=}$ Pendistar 33 EC @ 3.0 L/ha	Mutha	*Cyperus rotundus*	58	84	123	90
	Malancho	*Enhydra fluetuans*	7	10	8	6
	Durba	*Cynodon dactylon*	4	6	5	4
		Total	69		136	
$T_{6=}$Weed free (two hand weeding)	Mutha	*Cyperus rotundus*	12	85	47	95
	Malancho	*Enhydra fluetuans*	2	14	2	4
		Total	14		49	
T_{7}=Control (No Weeding	Mutha	*Cyperus rotundus*	64	82	187	90
	Chapra	*Elusine indica*	6	8	7	3
	Shama	*Echinochola crusgali*	4	5	6	3
	Durba	*Cynodon dactylon*	2	3	3	2
	Foska Begun	*Physalis minima*	2	3	3	2
		Total	78		206	

Table 3: Dry weight and weed control efficiency of Onion at 25 DAP and 50 DAP as affected by different doses of Pendistar 33 EC herbicide in Agronomy field, BARI, Gazipur and RARS Jessore during *rabi* season 2017-18.

Treatments	At 25 DAP				At 50 DAP				Mean	
	Weed dry weight m^{-2} (g)		Weed control Efficiency (%)		Weed dry weight m^{-2} (g)		Weed control Efficiency (%)		Weed control Efficiency (%	
	25 DAE				50 DAE				Gazipur	Jessore
	Gazipur	Jessore	Gazipur	Jessore	Gazipur	Jessore	Gazipur	Jessore		
T_1=Pendistar 33 EC @ 1.0 L/ha	15.56	12.53	69	23	60.50	25.34	32	17	50	20
T_2= Pendistar 33 EC @ 1.5 L/ha	14.34	13.23	72	20	57.34	24.54	36	19	54	28
T_3= Pendistar 33 EC @ 2.0 L/ha	10.24	8.76	80	47	38.00	20.36	57	33	69	40
T_4= Pendistar 33 EC @ 2. 5 L/ha	14.12	12.68	73	23	46.32	22.56	48	26	61	25
T_5= Pendistar 33 EC @ 3.0 L/ha	13.46	14.23	73	14	48.44	23.23	46	24	60	19
T_6= Weed free (twohand weeding)	4.21	2.45	92	85	6.57	12.56	93	59	92	72
T_7=Control (No Weeding)	50.56	16.42	-		89.25	30.43	-		-	

Table 4. Effect of different doses of Pendistar 33 EC herbicide on yield components and yield of onion in Agronomy field, BARI, Gazipur and RARS, Jessore during *rabi* season 2017-18.

Treat.	Plant height(cm)		Plant population (no./m^2)		Single Bulb Weight (gm)		Bulb yield (t/ha)	
	Gazipur	Jessore	Gazipur	Jessore	Gazipur	Jessore	Gazipur	Jessore
T_1	39.66	41.25	26	27	73.68	72.01	4.76	4.33
T_2	42.66	42.15	27	28	81.00	73.55	5.10	4.53
T_3	46.00	46.69	28	33	85.73	83.01	5.13	5.63
T_4	42.00	44.34	28	32	82.46	75.49	4.87	4.80
T_5	43.33	44.19	27	31	83.06	76.07	4.80	4.96
T_6	44.00	47.94	30	35	85.96	86.48	5.33	6.06
T_7	36.00	38.36	22	26	62.06	62.67	3.96	3.43
$LSD_{(0.05)}$	4.21	1.18	NS	1.59	11.09	2.94	0.62	0.32
CV(%)	5.63	1.52	7.67	2.96	7.88	2.18	7.17	3.72

Table 5. Economic performance of different doses of Pendistar 33 EC herbicide on Onion cultivation in Agronomy field, BARI, Gazipur and RARS, Jessore during *rabi* season 2017-18.

Treatments	Gross return (Tk/ha)		Total cost of production (Tk/ha)		Gross margin (Tk/ha)		BCR	
	Gazipur	Jessore	Gazipur	Jessore	Gazipur	Jessore	Gazipur	Jessore
T1	95200	86600	52000	52300	43200	34300	1.83	1.65
T2	102000	90600	53000	53000	49000	37800	1.92	1.72
T3	102600	112600	53100	53200	49500	59400	1.93	2.12
T4	97400	96000	54000	53800	43400	42200	1.80	1.78
T5	96000	99200	54300	54000	41700	45200	1.76	1.83
T6	106600	121200	72000	68000	34600	53200	1.48	1.78
T7	79200	68600	48000	47000	31200	21600	1.65	1.45

Price: Onion =Tk. 20/kg

T_1=Pendistar 33 EC @ 1.0 L/ha spraying at 3-4 DAT, T_2=Pendistar 33 EC @ 1.5 L/ha spraying at 3-4 DAT, T_3= Pendistar 33 EC @ 2.0 L/ha spraying at 3-4 DAT, T_4=Pendistar 33 EC @ 2. 5 L/ha spraying at 3-4 DAT, T_5= Pendistar 33 EC @ 3.0 L/ha spraying at 3-4 DAT, T_6= Weed free (two hand weeding), T_7=No Weeding (Control)

Economic performance

Cost of cultivation varied among the treatments due to variation cost of weeding (Table 5). Gross return was calculated the highest in T_6 (Tk 106600/ha) followed by T_3 (Tk 102600/ha) but the lowest in T_7 (Tk. 79200 /ha) at Gazipur and at Jessore, the highest gross return in T_6 (Tk 121200/ha) followed by T_3 (Tk 112600 /ha) but the lowest in T_7 (Tk. 68600 /ha)(Table 5). Higher gross return was found in T_3 and T_6 because of higher yield of onion (Table 5). But the highest gross margin (Tk. 49500/ha at Gazipur and Tk. 59400/ha at Jessore from Table 5) was noticed in T_3 due to lower cost involvement as compared to T_6. Similarly higher BCR was calculated in T_3 (1.93 at Gazipur and 2.12 at Jessore from Table 5) while lower values were observed in T_1 and T_7. Treatment T_6 failed to produce higher gross margin and BCR although it had the highest grain yield and gross return. This was happened due to higher cost involvement in T_6 for more number of weeding.

Conclusion

The result revealed that two hand weeding would be the best option for getting maximum yield of onion. But economic point of view, spraying of Pendistar 33 EC @ 2.0 L/ha spraying at 3-4 DAT might be economically profitable for controlling weed in onion field at Joydebpur and Jessore region.

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Declarations

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Author contributions

Subarna Kundu: Conceptualization, methodology, investigation, data collection, formal analysis, writing—original draft, and supervision. Tapas Chandra Bose: writing—review and editing. Mosammat Nazia Akhter: writing—review and editing. Nibedita Nath: writing—review and editing. Sandipan Sarker: writing—review and editing. All authors read and approved the final manuscript.

Clinical trial number

Not applicable.

Consent to participate

Not applicable.

Consent to publish

Not applicable.

Conflicts of interest

The authors declare that they have no competing interests.

Ethical approval

Not applicable.

Data availability statement

The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

Ethics and consent to participate

The onion (*Allium cepa* L.) plant material used in this study was cultivated under field experimental conditions at the Bangladesh Agricultural Research Institute (BARI). The cultivation, management and use of the plant material were conducted in accordance with applicable institutional and local agricultural guidelines. No wild plant material was collected for

this study. No specific permission or licence for the collection of wild plant material was applicable because the study involved cultivated onion plants in an agricultural field experiment.