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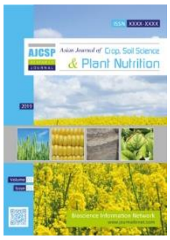

Effect of round-up as presowing application on yield of Wheat

Ahsan Ali[1], Golam Faruk[1], Abu Hena Sorwar Jahan[2], Afzal Hossain[3] and Samsul Huda[4]

[1]Regional Station, Bangladesh Wheat and Maize Research Centre, BWMRI, Gazipur-1701, Bangladesh.
[2]Bangladesh Agricultural Research Institute, BARI, Gazipur-1701, Bangladesh.
[3]Bangladesh Rice Research Institute, BRRI, Gazipur-1701, Bangladesh.
[4]Agricultural Research Station, BARI, Dinajpur-5200, Bangladesh.

Article correspondence: aahathazari@gmail.com (Ali, A)
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ABSTRACT

To learn the dose and when to apply round-up prior to seeding wheat in a late-sown climate, a field experiment was undertaken at the Regional Wheat Research Center of BARI's Joydebpur site in Gazipur during Rabi season 2019-20. Four optimum doses and specific time of application were applied as pre-emergence. The treatments were T_1= round-up application @3 liters/ha at 5 days before sowing (DBS), T_2=round-up application @6 liters/ha (3+3) at 5, 10 DBS, T_3=round-up application @9 liters/ha (3+3+3) at 5, 10 and 15 DBS, T_4=round-up application @12 liters/ha (3+3+3+3) at 5, 10, 15 and 20 DBS and T_5= No round-up application (Control). The best weed control is accomplished by round-up application @ 6 liters/ha (3+3) at 5, 10 DBS. In randomized complete block design (RCBD), three replications were performed. Major weeds like Bathua (Chenopodium album), Biskatali (Polygonum hydropiper), Maloncha (Alternanthera philoxeroides), Banpalong (Sonchus arvensis) Chapra (Elusine indica), Banmasure (Vicia sativa) were found in experimental plots. As profoundly lower weed count m^2 (125) in T_4=Round up application @12 liter/ha (3+3+3+3) at 5, 10, 15 and 20 DBS and Maximum weed control efficiency (78%) was found when round-up was applied @ 6 liters/ha (3+3) at 5, 10 DBS and applied @ 9 liters/ha at 5, 10, and 15 DBS at both 25 and 50 DAE. Number of spikes/m^2 and biological yield of wheat showed a significant difference and the remaining parameters were insignificant. With round-up treated at 6 liters per hectare at 5 and 10 DBS, a 2.43-t/ha grain yield was obtained. The control plot's lower grain yield (1.71 t/ha) was discovered to be a numerical value. The BCR of 1.16 was discovered when round-up was administered at 6 liters per hectare (L/ha) at 5 and 10 DBS.

Key Words: *Herbicide (Round-up, Glyphosate), Pre-application, Weeds control and Wheat Yield.*

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I. Introduction

In Bangladesh, wheat is the second most important grain crop. 1.5-2% of the country's GDP comes from wheat, which adds value to the agriculture industry. In the 2019-20 season, the production area of wheat increased 2% than last year, inspired by some districts where wheat blasts were affected. In total, the country can produce 12 million tons of wheat. Overall, the production is high in wheat production area through good technology, favorable environment, good market price, and short duration of Amon rice crop. An average yield of wheat is about 3.40t/ha. Wheat yield is lower than world average yield and other wheat growing countries worldwide (FAOSTAT, 2013 and BBS, 2019).

The weeds that grow with crops compete for nutrients, space and solar radiation, so crop's poor growth and development result in yield reduction. In our country, weeds infestation is very high at the end of December; for this reason, yield reduction is about 30-50%. Infestation of Weeds in the wheat field decreases the yield crop by 10 to 17% (Jalis and Mohammad, 1980). Weeds and their branches are barriers and specific factors in yield production also problems for threshing, harvesting (Noorka et al., 2013). Weeds are a great problem for the crops because the nearest contender has crop plants for soil moisture, radiation, light, space, and plant nutrients (Khan et al., 2001). Weeds competition to the plants for nutrients, space, air, light, water and other parts of the growth aims, which less yield become poor quality of production and low market demand (Qureshi, 1982). Crop sensitivity of the cereals always competes with some of the herbicides (Sikkema et al., 2007). The quality of crops is also reducing by weed infestation. Weed infestation is a great problem for this law yield by 24 to 58% (Hossain et al., 2010). Weeds are an important limiting factor in the wheat field for arid regions because it competes for evapotranspiration with plants for soil moisture, water, radiation, space and same light (Donald and Eastern, 1995). As a result, grain yield loss of 8% (Shah et al., 2005), 51%, 91% (Tiwari and Parihar, 1997), 26% (Dangwal et al., 2012) by seriously weed infestation. If the weed increase rapidly day by day, at one stage crop would be a complete failure. Generally, wheat fields are spread with both monocot and dicot weeds. Normally wheat fields infested 20 to 25 types of weed species under 10 to 15 families. In general, Bangladesh is overrun by a multitude of invasive plants, among them are several species of C*henopodium album, Oxalis europaea, Polygonum hydropiper, Cynodon dactylon, Eleusine indica, Digitaria sanguinalis, Cyperus rotundus, Physalis heterophylla, Vicia hirsuta, Hedyotis brachypoda, Stellaria media* (Hossain et al., 2010). Increasing wheat crop growth and yield maximization will improve wheat yield production. Constant pressure on other agricultural commodities would make it difficult to obtain large wheat yields and regions would be exhausted (Negash et al., 2005). Heavy weeds crop management is extremely costly, making harvesting and threshing difficult (Noorka and Shahid, 2013; Khalil et al., 1993).

Today, controlling weeds with chemicals is a highly current agricultural science issue (Khan et al., 1999). Effective weed control has been established in wheat fields by the use of pesticides. So much time has passed since the registered herbicides for cereal crops were approved that no new ones have been introduced (Ontario, 2013). Round-up was used to control weeds in wheat fields before plant emergence. Due to the manpower shortage faced by Bangladeshi farmers, farmers do not prioritize weed control in wheat crop fields. In the past, farmers in Bangladesh have relied on hand weeding one or two times to control weeds; however, this is a far more time- and money intensive process. According to the Wheat Research Centre of Bangladesh (WRC, 2007), using licensed herbicides to combat weeds in wheat fields is acceptable. Although it was adequate for weeding out wheat, it was not enough for total weed control. Effective herbicides, correct application and fixed-dose are the most crucial aspects for a greater yield. This experiment was performed to find the ideal dose and period of application before seeding wheat to get the maximum yield.

II. Materials and Methods

Experiment location and weather

An experiment was done in the Wheat Research Institute in Gazipur, Bangladesh, during the rabi harvest season (December 27, 2019, to March 2020). In the Agro-Ecological Zone, the soil is Silky clay loam with a ph of 6.3. (AEZ 28). In the rabi season, the trial period means temperatures ranged from 120 degrees Celsius to 330 degrees Celsius. For the specified periods, the humidity was between 65% and 90%. In January, sunshine was on average 4 hours each day; however, it was 8 hours each day in March. The rainfall in November was approximately 23mm, while March's precipitation was about 14mm, and April's measurement was about 75mm in the research area.

Experiment design

In the 2019-20 Rabi season, researchers used a randomized complete block design (RCBD) with five treatments and three replications to conduct their experiment. The research plot consisted of 10 rows

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and 2 meters by 3 meters long and was laid out in line with 20 centimeters between rows and continuous sowing after one inch.

Treatments	Details
T_1	Round-up application @ 3 liters/ha at 5 days before sowing (DBS)
T_2	Round-up application @ 6 liters/ha at 5 and 10 DBS
T_3	Round-up application @ 9 liters/ha at 5, 10 and 15 DBS
T_4	Round-up application @ 12 liters/ha at 5, 10, 15 and 20 DBS
T_5	No round-up application (Control).

Experiment soil types

Soil samples were collected from the research experimental field area and sent to the laboratory to analyze physicochemical characteristics. A soil pH of 6.3 was found in the experiment field area, lack of organic materials in the soil (5 g kg soil) with total N (4.5 g kg soil) and P (7mg P kg soil).

Experiment procedure.

BARI Gom 33 (seed rate of 140 kg/ha) was used as a tested variety in this experiment. The crop was fertilized with cow-dung 5 ton /ha and 230-150-100-110-20-10 Kg/ha of NPKSZB, respectively. Cow dung was applied at the time of land preparation. Two-third of the N and the rest of the other chemical fertilizers were applied in the last cultivation of the land preparation. The remaining one-third of N was applied as a top-dressing 17-21 days after sowing, corresponding to the CRI stage after irrigation. Weed samples were collected at 25 and 50 DAE from four randomly selected locations using a 1mx1m quadrate from each weed plot, and fresh weight and oven-dry weight of weed data were recorded. Weed samples were oven-dried at 700c for 72 hours until the weight was constant. The crops were harvested March 21, 2020. Grain yield and yield contributing character were recorded and analyzed statistically according to the software of statistic-10. Means data were adjusted by LSD value test at 5% level of significance.

Relative weed density =(A/B) X 100	A=specific number of weed B=total number of weed
Weeds control efficiency (WCE) %=(A-B)/AX100	A= dry weight of weeds in no weeding plot B =dry weight of weeds in treated plots.

Weather information's of the experimental area.

All weather information data was taken from the weather observation Centre of BARI campus in Gazipur. The data was including weekly mean maximum, minimum air temperature, rainfall, sunshine hour and Humidity (Figure 01).

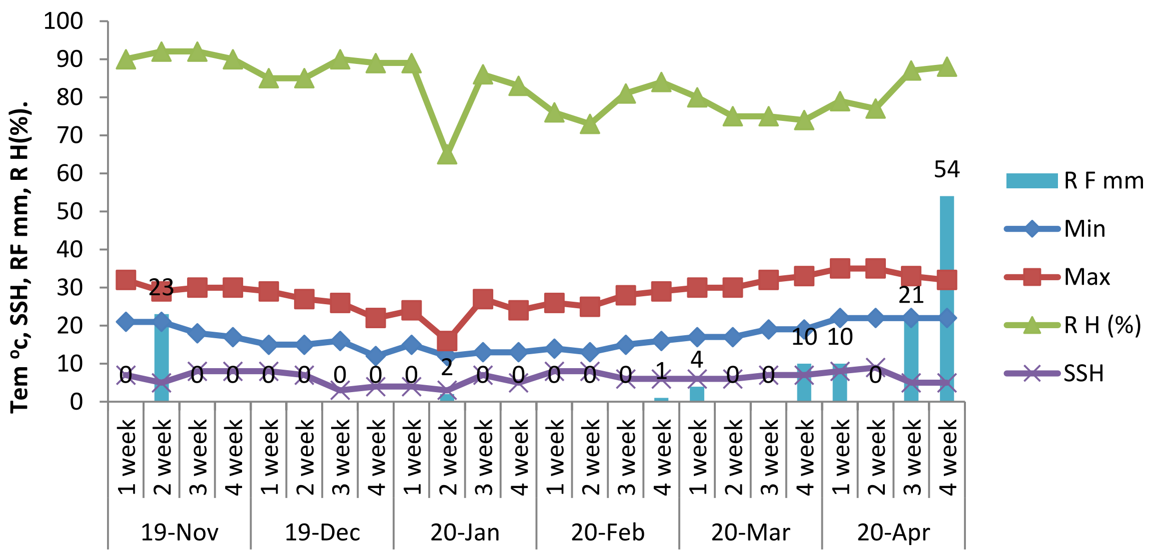

Figure 01. Six month weather condition during 2019-20
Source: Weather observation station of BARI campus in Gazipur.

III. Results

Weed flora

Weed species, number of weeds/m² and weed density (%) were calculated in different doses and different time applications of herbicide (Table 01). It was found that Bathua (C*henopodium album*), Biskatali (P*olygonum hydropiper*), Maloncha (*Alternanthera phetoxeroides*), Banpalong (*Sonchu sarvensis*), Chapra (*Elusin indica*) were the common dominant weeds at regional wheat research centre field, Gazipur. However, we observed that Biskatali (P*olygonum hydropiper*) was mainly dominant and not controlled by applying all the treatments. It was observed that round-up herbicide killed successfully within a week, while after 25-30 of application, all weeds emerged again with little growth. In table 01 we observed Biskatali weed high amount in all treatments.

Table 01. Effect of different doses and time of application of herbicide (round-up) on weeds species, weeds number/m² and weed density (%)

Treatments	Local Name	Scientific Name	25 DAE		50 DAE	
			Weed/m² (No)	Weed density (%)	Weed/ m² (No)	Weed density (%)
T_1	Bathua	*Chenopodium album*	13	7	4	3
	Biskatali	*Polygonum hydropiper*	120	66	105	74
	Maloncha	*Alternanthera philoxeroides*	-	-	-	-
	Banpalong	*Sonchus arvensis*	3	2	-	-
	Chapra	*Elusine indica*	47	26	38	26
	Bonmasur	*Vicia sativa*	-		-	-
		Sub Total	183		147	
T_2	Bathua	*Chenopodium album*	4	3	3	2
	Biskatali	*Polygonum hydropiper*	113	81	110	84
	Maloncha	*Alternanthera philoxeroides*	3	2	1	1
	Banpalong	*Sonchus arvensis*	-	-	-	-
	Chapra	*Elusine indica*	20	14	17	13
	Bonmasur	*Vicia sativa*	-			
		Sub Total	140		131	
T_3	Bathua	*Chenopodium album*	8	9	16	8
	Biskatali	*Polygonum hydropiper*	117	58	116	59
	Maloncha	*Alternanthera philoxeroides*	2	1	2	1
	Banpalong	*Sonchus arvensis*	1	0.5	-	-
	Chapra	*Elusine indica*	65	32	62	32
	Bonmasur	*Vicia sativa*	-	-	-	-
		Sub Total	203	-	196	-
T_4	Bathua	*Chenopodium album*	9	8	9	8
	Biskatali	*Polygonum hydropiper*	95	76	92	77
	Maloncha	*Alternanthera philoxeroides*	2	2	-	-
	Banpalong	*Sonchus arvensis*	1	1	1	1
	Chapra	*Elusine indica*	18	15	18	15
	Bonmasur	*Vicia sativa*	-	-	-	-
		Sub Total	125	-	120	-
T_5	Bathua	*Chenopodium album*	26	6	31	7
	Biskatali	*Polygonum hydropiper*	117	29	151	30
	Maloncha	*Alternanthera philoxeroides*	16	4	16	3
	Banpalong	*Sonchus arvensis*	24	6	24	5
	Chapra	*Elusine indica*	265	65	231	43
	Bonmasur	*Vicia sativa*	62	15	51	10
		Sub Total	410	-	504	-

T_1= round-up application @ 3 liters/ha at 5 days before sowing (DBS), T_2=round-up application @ 6 liters/ha at 5 and 10 DBS, T_3=round-up application @ 9 liters/ha at 5, 10 and 15 DBS, T_4=round-up application @ 12 liters/ha at 5, 10, 15 and 20 DBS. T_5= No round-up application (control).

On the other hand, round-up failed to kill Biskatali might be some other unknown reason. The herbicidal treatments always suppressed the growth of the different weeds. Weeds density (125 m² and 120 m²) at 25 and 50 DAS, respectively, was achieved in plot where round up application @ 12 liters/ha at 5, 10, 15 and 20 DBS. Follow by weed density (140 m² and 131 m²) at 25 and 50 DAS, where round-up application @ 6 liters/ha at 5 and 10 DBS. The highest weed density was (410 m² and 510 m²) at 25 and 50 DAS where there was no used round up herbicides that was control. This result showed that if round up application @ 6 liters/ha at 5 and 10 DBS, is most effective for weed control in wheat field. Weed infestation per specific location was effective for weed control in general. As more weed infestation and crop plant competition occur in the plot, the nutrient degraded from the soil.

Weed dry weight and weed control efficiency (%) (WCE)

The results showed that weed control efficiency was effectively affected by different doses and specific times of round-up herbicidal treatments. We found maximum density and infestation of weed in control plots. The application @6 liters/ha at 5 and 10 DBS was economically maximum in the treatment plot. Round-up application @6 liters/ha at 5 and 10 DBS presented less weed and weed biomass, representing maximum weed control efficiency (78%) among all experiment treatments (Table 02). The heights dry weight of weeds in the control treatment 124g/m^2 at 25 DAE and 121g/m^2 at 50 DAE. The lowest dry weight of weeds in the treatment T_3 26 g/m^2 at the 25 DAE and 25 g/m^2 at 50 DAE followed by treatment T_2, T_4 and T_1 in Table 02. Weed control efficiency (WCE) was high with the appropriate quantity of herbicide at right time. Variation in the weed control efficiency (WCE) was observed among different doses of herbicide. In the experiment treatment (78%), weeds were controlled in the plot where round-up application @6 liters/ha at 5 and 10 DBS was applied following treatment T_3, T_4 and $T_{1,}$ respectively, at both 25 and 50 DAE. It was found that round-up showed better results regarding WEC (%) in a range 71-78 compared with control plots due to the efficacy nature of herbicides. Sharma and Sing (2006) mentioned that the spray of Gramoxone Inteon was fully controlling efficacy to compared almost similar by different doses of herbicide. All Gramoxone conduct controlled more than 80% of the weeds. In this study, we have found the minimum weeds control efficiency was 71% in round-up application @ 3 liters/ha at 5 days before sowing (DBS). We also found that non-selective herbicide (round up, 6 liters/ha at 5 and 10 DBS) was becoming more effective and vital for controlling weed for the wheat cultivation in the country.

Table 02. Effect of different doses and time of application of round-up on dry weight of weed and weed control efficiency (WCE) in wheat

Treatments	Dry weight of weed (g/m^2)		Weed control efficiency (%)		Mean weed control efficiency (%)
	25 DAE	50 DAE	25 DAE	50 DAE	
T_1	37	35	70	71	71
T_2	28	27	77	78	78
T_3	26	25	78	78	78
T_4	32	31	74	74	74
T_5	124	121	-	-	-

T_1= 1 spray @3 L/ha (5 DBS), T_2 = 2 spray @ 6 L/ha (5+5 DBS), T_3 = 3 @ spray 9 L/ha (5+5+5 DBS), T_4 = 4 spray @12 L/ha (5+5+5+5 DBS), T_5 = No spray (Control)

Yield and yield contributing characters of wheat

Except for spike/m^2 and biomass, remaining parameters like plants population/m^2, anthesis (days), plant height, spike length, maturity (date), 1000-grain weight, grain yield and harvest index of wheat did not show any significant difference as influenced by different dose as well as time of herbicide application presented in (Figure 02, Figure 03, Figure 04, Figure 05, Figure 06, Figure 07, Figure 08, Figure 09, Figure 10 and Figure 11).

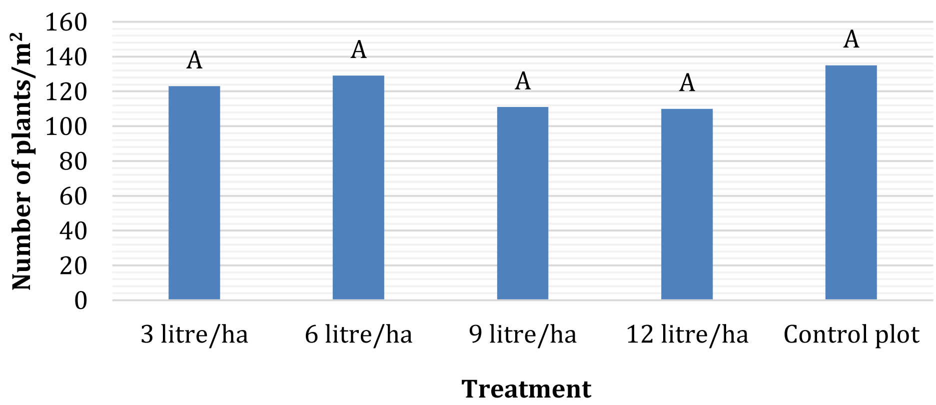

Figure 02. Effect of different treatment on number of plant population.

Plant population/m²: Different concentration of weed control treatment on pre sowing application no influence on wheat Germination and development. The treated herbicide doesn't differ significantly among crop growth at CRI (Crown Root Initiation) stage (Figure 02). The maximum value of PP (135 m^2 day^{-1}) was recorded in the control plot. Application of round up@ 6 liters/ha at 5 and 10 DBS (129 m^2 day^{-1}) was second effective treatment. Among the herbicide treatment, minimum PP (110 m^2 day^{-1}) was absorbed in round-up @12 liters/ha at 5, 10, 15 and 20 DBS, in CRI stage. The fourth PP (111 m^2 day^{-1}) was recorded in round-up application @9 liters/ha at 5, 10 and 15 DBS and fifth PP (123 m^2 day^{-1}) were recorded in the experiment. At the early stage of the crop, the plant phonological development was lesser because some herbicidal effect slowed the growth of plants.

Number of spikes/m²: The highest spike (231) was among the treatment when round-up application @ 6 liters/ha at 5 and 10 DBS at 65 DAS and the lowest number spike was (127) in the control plot. The second highest effective spike (215) was found in the treatment of round-up application @ 3 liters/ha at 5 days before sowing (DBS) and third and fourth effective spike (213), (187) was found (Figure 03) subsequently in treatment of round-up application @9 liters/ha at 5, 10 and 15 DBS and round-up application @12 liters/ha at 5, 10, 15 and 20 DBS. Lowest spike was found in control plot because of high amount of weeds grown in control plot. Experiment result showing high the number of spike may be deeply related to better weed control which gets more translocate and photosynthetic work diverse growth due to less weed competition. Same dialogue from Malik et al. (2009) and Khan et al. (2000) subscribed significantly affected of spikes/m² by different weed chemical control practices.

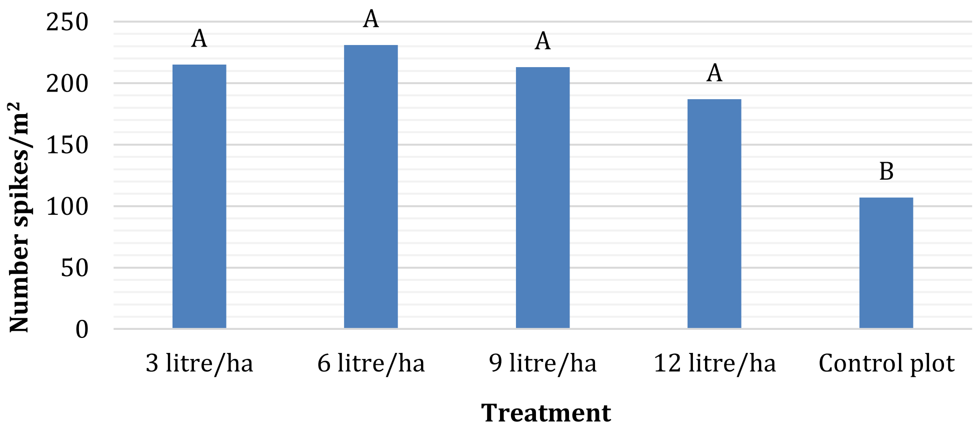

Figure 03. Effect of differents on number of fertile tillers/spike

Anthesis of wheat (days): Days to anthesis were not significant among the treatments (Figure 04). It can be said that all the treatments were sown the same date and need accurate time (days) for anthesis. It was noticed that treatment T_1 showed the highest anthesis (67) days. We found in the study, T_2, T_3 and T_4 were the same (65) days of anthesis. The lowest anthesis (64) days was found in the control plot. The physiology of days to wheat cultivar shows the anthesis variation by different inheritance between wheat (Shahzad et al., 2007).

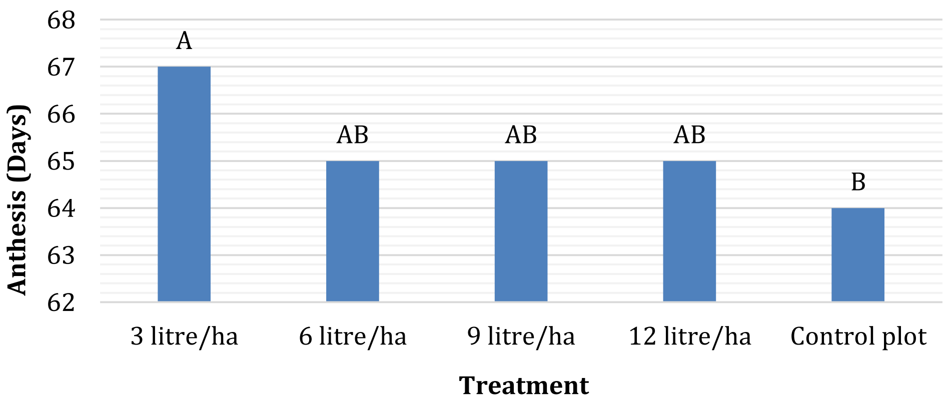

Figure 04. Effect of different treatment on anthesis days.

Plant height (cm): Plant height is full regulation of the genetics and the wheat environmental condition, which becomes to biological yield production of the crop (Figure 05). Plant height, number of spikes, spike length, spikelet/spike, anthesis, maturity and biological yield are directly growth regulators of the plant growth progress of all cereal crops. The maximum plant height (92 cm) was found in T_2 and T_5. Increase wheat plant height may be accurate kind of weed suppression at the right time in air, space, light, moisture and nutrients by the crops (Ahmed et al., 1995). The lowest plant height (88 cm) was recorded in T_4. It may be due to injury by the high concentration of herbicide Abbas et al. (2009). The second plant height (90 cm) was recorded in treatment T_1 followed by T_3 (89 cm). It indicates that the right amount and time of herbicide affected in the treatment T_2 results in a high plant height. Some reporters also descried that herbicide did not the significantly effect of wheat plant height but accurate herbicide has significant preclusive effect on wheat plant height (Quimby and Nalewaja, 1966; Bibi et al., 2008).

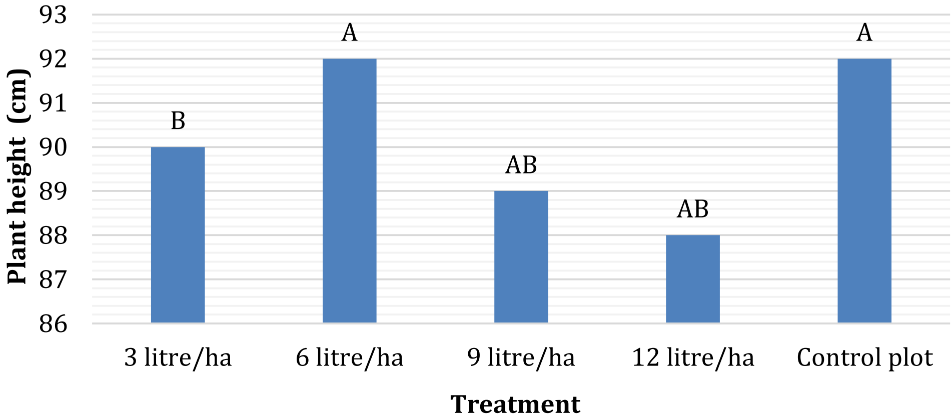

Figure 05. Effect of different treatment on plant height of wheat

Spike length of wheat (cm): From Figure 06, it was found that maximum spike length (11 cm) was observed with T_2 and T_3. Healthy plant growth from low weed competition in treated field and gets more air, light, space, moisture and nutrient that causes healthy plant growth and increase spike length by chemical weed control methods as well as documented by Ahmad et al. (1995), Verma and Kumar (1986) and Bhan (1987) followed by treatment T_1 (10 cm) and T_4. The lowest spike length was recorded in the study (9 cm) treatment T_4. Not increase healthy wheat plants by less weed control with specifically mentioned herbicide in the experiment for light, oxygen, water, CO_2 and water from others became less spike length.

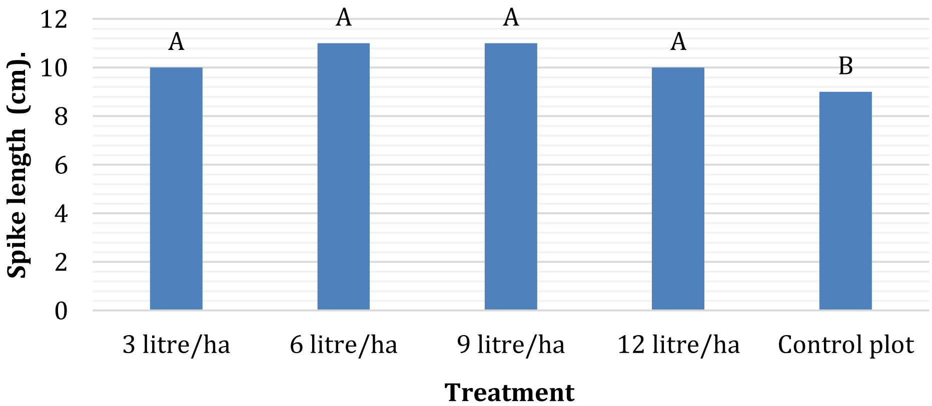

Figure 06. Effect of different treatment on spike length of wheat

Maturity (days): It was observed in (figure 07) that last crop sown year; the sowing date to days to harvest of physiological maturity was not statistically similar. Normally wheat maturity is 100 to 110 days. In this study, all the treatments became maturities 82 to 88 days. Due to late sown planting of the crop and facing high temperatures at grain-filling maturity, the crop life becomes reduced. The highest maturity day was observed from T_1 and T_2 (88 days). The lowest maturity (82 days) days was in control plots (T_5) because of poor weed control compared to others implicated for moisture, water, light, space, CO_2 and O_2. The second maturity (86 days) was treatment T_3 and T_4. May be little effect on the wheat maturity. Fischer (1990) mentioned that in the late sown condition, the crop plants hastens the growth development, short duration, reduce life cycle and yield from sowing to harvest by imposed high temperature.

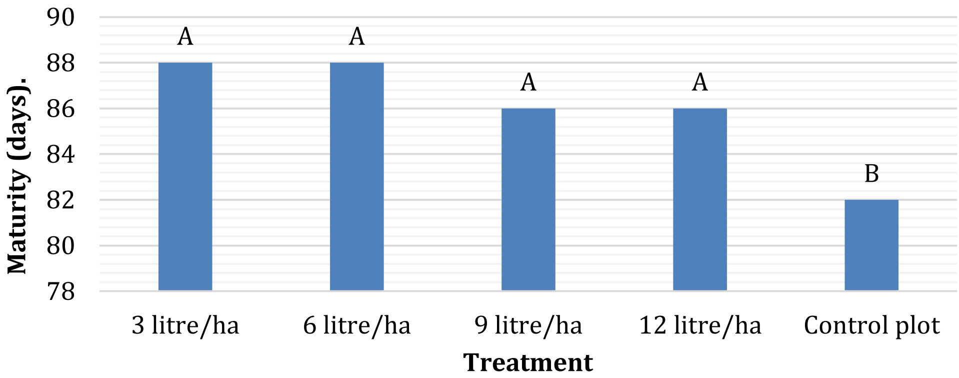

Figure 07. Effect of different on Maturity days.

1000 grain weight: In wheat subsequently decrease in 1000 grain weight (TGW) by late sowing was reported Joarder et al. (1981). Short duration of each development growth, less grain-filling periods, lowers the grain weight by late sowing because of an unfavorable environment for floret formation and grain filling condition (Spink et al., 2000). Our present study found that December 27 sowing produces lower grain and spike (Figure 04). We observed in the weather chart that the temperature was very high sowing to grain filling condition (double ridges stages, GSI) of the crop, which more affected the formation of floret and grain filling as a resulted in lower grains and spike in late sowing condition (O'Toole and Stockle, 1999) (Figure 08). Above 30^0 Temperature during the formation floret and grain filling may be completely sterility and reduce grain filling to become the lowest 1000 grain weight. Another side was poor weed control in the plot; the weed competition for water, air, lite, space and nutrient for their vegetative growth reduces the spike, spike length and thousand-grain weights (TGW). Production lowest 1000 grain weight was (Figure 04) 28g in control plot. It might be due to uncontrolled weed and unfavorable temperature at growth stage of crop, especially grain-filling stage. The high production of 1000 grain weight (47g) was in the treatment T_2 followed T_1, T_3 and T_4. It may be due to high concentration of mixture use in plots as wheat plant hard and little effects to grain-filling and high temperature may be shorter weight of 1000 grain. That is why wheat plant was little injured and gets lower 1000 grain weight.

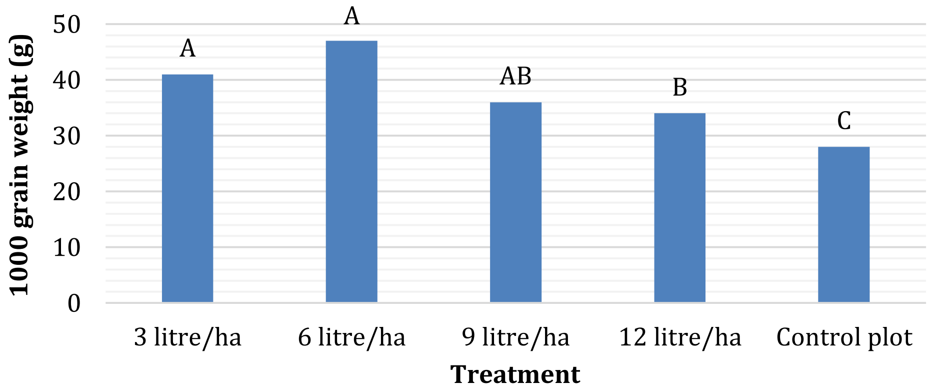

Figure 08. Effect of different on thousand grain weight of wheat

Biological yield of wheat (t/ha): The data revealed that biological or biomass yield was significantly affected by round-up as presowing application (Figure 09). The highest biomass yield (7.22 t/ha) was obtained in T_2. It may be favorable weed control and obtained might be due to cumulative effect of wheat plant increased vegetative growth, tillering, number of leaves, spike bearing tillers, high plants height, spikes/m², grains/spike and 1000 grain weight, followed by T_1= (7.16 t/ha). The lowest biomass yield was found in the control plot (3.87 t/ha). It may be due to the no active performance of herbicide (no use) in to control plots. A huge number of weeds were grown in the control plots and competition for environmental elements and nutrition become wheat plants weak and very few biomass was found in control plots. In $T_{2,}$ the right time and accurate concentration of herbicide were applied in that treatment. As a result, a few weed and wheat plants were bigger and more also increased biomass. The second biomass (7.16 t/ha) was in treatment T_1 while third and fourth biomass (6.68 t/ha), (6.46 t/ha) was in treatment T_3 and T_4. Some reporters observed timely right concentration of herbicide increased biomass in wheat (Malik et al., 2009; Roslon and Fogelfors, 2003).

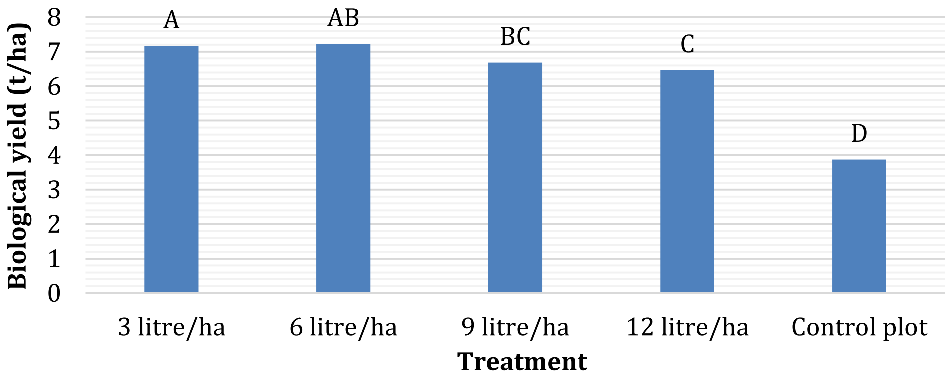

Figure 09. Effect of different treatment on biological yield of wheat.

Grain yield of wheat (t/ha): In the wheat crop, high grain yield is the most important and determinative parameter of all agricultural experiments in Bangladesh. Individually use different concentrations of herbicide among the treatment, the most important data (Figure 10) showed the highest wheat grain yield (2.43 t/ha) was found in T_2 followed by T_1 (2.13 t/ha), T_3 (2.06 t/ha) and T_4 (2.01 t/ha). T_2 was less weeds plants get more environment element and nutrient become increased plants healthy and good yield than other treatment. Higher grain yield from herbicide treated experiment plots may be right of efficient weed control achievement in the place (Abbas et al., 2009; Marwat et al., 2008; Tunio et al., 2004). Everybody described that right concentration and time of herbicide application before the sowing has increased wheat grain yield. The lowest wheat grain yield (1.71 t/ha) was obtained from control plot. Maybe there was no use of herbicide (control) as weed competition was high and huge number of weeds were grown there, wheat plants were sick and finally got very few yield. Wheat yield deeply correlated with weeds growth. Same report from Khaliq et al. (2011) and Rinella et al. (2001).

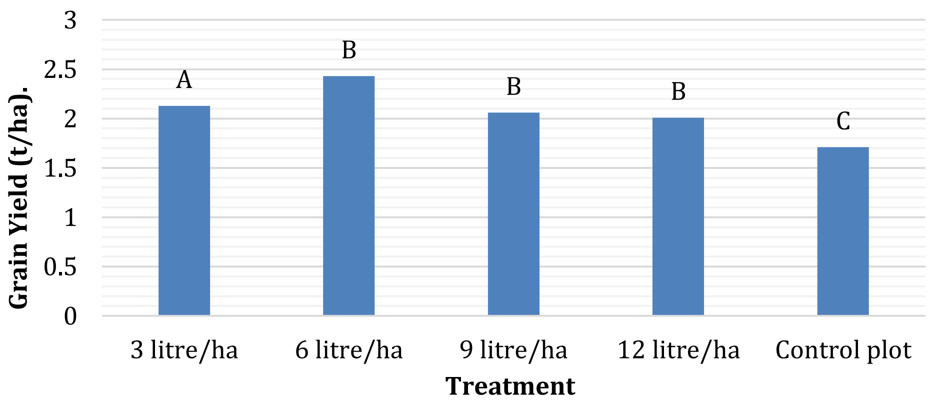

Figure 10. Effect of different treatment on grain yield of wheat.

Harvest index of wheat: Singh et al. (1990) reported that harvest index is the most important indicator parameter for selecting high yielding varieties in the research system. A high value of harvest index indicates the right utilization of photosynthesis and high yields under drought stress condition (Gifford et al., 1984; Blum et al., 1994). In our present study (Figure 11), it was not significant effect between high temperature and normal concentration. Treatment T_5 (44) was with the highest harvest index (HI) followed by T_4 (33) and T_3 and T_1 (30). The lowest harvest index (27) was found in T_2. Grain yield and harvest index is deeply related with high temperature of (31^0c) at 79 DAS. Same results were reported by Ferris (1998). We found from the study that this herbicide of higher harvest index has lower biomass and lower grain yield.

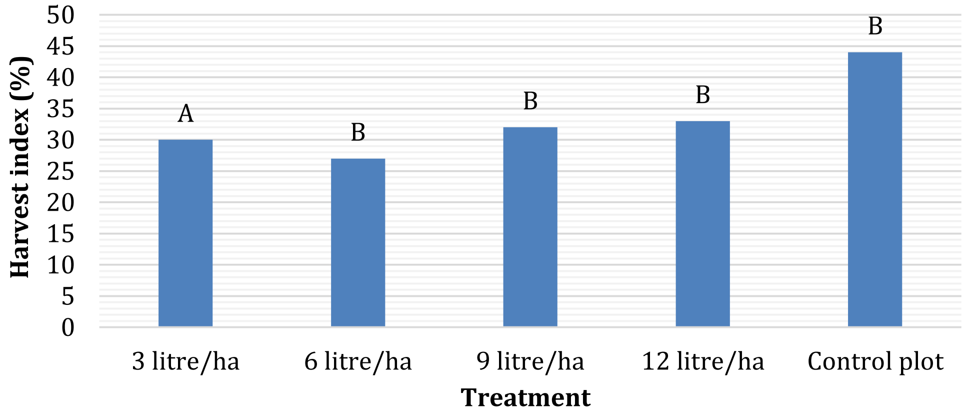

Figure 11. Effect of different treatment on harvest index of wheat.

Economic performance

The economic analysis found that the maximum cost of production was recorded in treatment T_4 (Tk. 46700/ha) followed by T_3 (Tk. 44300/ha). Maximum gross return of (Tk. 48600/ha) was observed in treatment T_2 followed treatment T_3 (Tk. 41200/ha). T_2 treatment showed maximum benefit-cost ratio (BCR) is (1.16) followed by treatment T_1 (1.07) in (Table 03). The lowest BCR (0.86) was obtained from treatment T_5 (control). Those findings were found might be due to the effect of high value herbicide use.

Table 03. Economic performance of different doses and time application of round-up (herbicide) of wheat cultivation during Rabi 2019-20

Treatment	Gross return (Tk/ha)	Total cost of production (Tk/ha)	Gross margin (Tk/ha)	BCR
T_1	41000	39500	1500	1.07
T_2	48600	41900	1700	1.16
T_3	41200	44300	- 1300	0.93
T_4	40200	46700	- 6500	0.86
T_5	34200	39500	- 5300	0.86

Local wheat market price = 20/- Round up price =800/-, Labor Daily price 500/- T_1= 1 spray @3 L/ha (5 DBS), T_2 = 2 spray @ 6 L/ha (5+5 DBS), T_3 = 3 @ spray 9 L/ha (5+5+5 DBS), T_4 = 4 spray @12 L/ha (5+5+5+5 DBS), T_5 = No spray (Control).

IV. Discussion

In the present study, split application of round up as pre-sowing on weeds control efficiency and yield contributing characters of wheat. Maximum plant population/m² was found in treatment T_5 (Control), which might be due to no application of round up, while minimum was found in T_4 treatment (though those results were not statistically different) might be due to the harmful effect as well as high concentration of maximum doses of round-up application (Table 02). Similar findings were obtained by Khaliq et al. (2014). He reported that applying different concentrations of herbicides resulted in a correlatively lower plant population than the untreated control plot of wheat. The highest spike/m² was found in treatment T_2 and lowest in treatment T_5, which might be due to more translocation of photosynthesis toward vegetative growth due to less competition (Malik et al., 2009; Khan et al., 2000) also reported similar results. The treatment had no discernible effect on anthesis. High concentration treatment doesn't reduce plants' height of wheat (Abbas et al., 2009). Also anti reported by Bibi et al. (2008). Spike length becomes shorted due to competition with wheat plants for natural nutrients (Ahmed et al., 1989; Bhan, 1987). There was no significant difference in physiological maturity among the treatment. However, delayed sowing shortens each development stage of the wheat life cycle (Spink et al., 2000). The highest 1000 grain weight was treatment T_2 gets more nutrients, moisture, water and light, CO_2, O_2, due to less weed competition. Anti-result was found treatment T_5 (Asad and KAbuzar et al., 2017; Abbas et al., 2009; Bibi et al., 2008; Ahmad et al., 1995). Plant height, leaf area and growth of morphological traits were higher than increased biological yield in treatment T_2 due to an appropriate herbicide concentration. In control plots, huge amounts of different weeds were grown as poor performance and lowest biomass. Same as Malik et al. (2009) and Abbas et al. (2009). The concentration of round-up was very high in treatment T_4 and T_3 for this reason, plants some injury makes little lower

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biomass. Concentration of herbicide application and time was related to biomass. This result was confirmed by Asad et al. (2017). Higher grain yield was found in treatment T_2 causes through right concentration and timely sprayed becomes bold grain yield (Johnson et al., 2002). Herbicides treated plots gives good outcome by efficient mixture and timely application. A similar report was found by Abbas et al. (2009), Marwat et al. (2005) and Tunio et al. (2004). Weed density and biomass both harm wheat yield (Khalik et al., 2011; Rinella et al., 2001).

V. Conclusion

The farmer prefers herbicide for the maintenance of weeds. Round-up is the main function of pre-sowing applications for weed management. The study results conclude that the application of Roundup @ 6 liters/ha at 5 and 10 days before sowing may be suitable for getting weed management, higher yield and economic return for very late sown (27 December) wheat cultivation.

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