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INLUENCE OF DIFFERENT LEVELS OF COWDUNG ON MITIGATION OF WATER DEFICIT EFFECT ON WHEAT

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Abstract

The experiment was conducted in pot at the net house of the department of Agronomy, Sher-e-Bangla Agricultural University, Dhaka during the period from November, 2018 to March, 2019to find out the optimum dose(s) cowdung to mitigate the water deficit effect on wheat. The experiment comprised of two factors viz. factor A: Five levels of cowdung, i) C_0= Control (No cowdung), C_1= 25% less cowdung of recommended dose, C_2 = Recommended dose of cowdung, C_3 = 25% higher cowdung of recommended dose and C_4 = 50% higher cowdung of recommended dose, and factor B: four levels of water deficit at, i) D_0 = Control (No water deficit), D_1= Crown root initiation stage (20-19 DAS), D_2 = Booting stage (45-54 DAS) and D_3= An thesis stage (55-64 DAS). The experiment was laid out in a Factorial R and omized Complete Block Design with three replications. The test crop variety was BARI Gom28. The result reveled that cowdung level had positive impact on yield of wheat under water deficit condition, and 50% higher cowdung of recommended dose (C_4) gave the highest grain yield (5.12g plant^{-1}). The particular treatment also produced the highest number of effective tillers plant^{-1} (5.25), spike length (10.39 cm), spikelet spike^{-1} (15.72), grains spike^{-1} (32.56), grains spikelet^{-1} (2.07) and 1000-grain weight (47.32 g) of wheat. The treatment C_3 (25% higher cowdung of recommended dose) also gave statistically similar yield with C_4 treatment. In respect of water deficit imposition treatments, grain yield was found the highest in control treatment which was statistically similar with water deficit imposition at booting stage treatment (D_2). These two treatments also showed the higher and similar number of effective tillers plant^{-1} (4.86 and 4.58), spike length (10.53cm and 10.11cm), spikelets spike^{-1}(15.50 and 15.19), grains spike^{-1} (34.10 and 30.17), grains spikelet^{-1} (2.20 and 1.98) and 1000-grain weight (45.42g and 45.36g, respectively). Regarding the interaction of levels of cowdung and water deficit imposition at different stages of plant growth, C_4D_0 and C_3D_0 were highest yielder which was attributed to higher 1000-seed weight, number of effective tillers plant^{-1}, spikelets spike^{-1} and grains spike^{-1}. Contrary, 25% higher cowdung than recommended dose (as it saved 25% cowdung) seems promising to overcome yield loss due to water deficit imposition at booting stage of wheat (D_2). However, application of cowdung (12.5 t ha^{-1}) was found effective to combat water deficit at booting stage (D_2) of wheat compared to other growth stages.

Introduction

Wheat production of Bangladesh was 11.0 lac metric tons and area cover 3.5 lac hectares (BBS, 2019). Drought affects all plant development stages from germination, vegetative and

reproductive growth to grain filling and maturation of the crop (Hossain *et al.,* 2012). Drought reduces nitrogen (N) uptake efficiency and utilization by plants. Drought is one of the major abiotic stresses that affect at least 60% of wheat production in high-income countries and about 32% of 99 million hectares in least developed countries (Chen *et al.,* 2012). Water deficit might decrease wheat grain yield from 17 to 70% (Nouri-Ganbalani *et al.,* 2009). Daryanto *et al.* (2016) reported 20.6% yield losses in 40% reduced water. Sarwar (2005) found that grain yield and yield components of wheat significantly increased with the application of different organic materials resulting in the compost to be the most superior one. In addition, Yassen *et al.* (2006) found that the irrigation at 60% water holding capacity and applying mineral 60kg $Nfed^{-1}$, with presence of the chicken manure as an organic fertilizer produced the highest wheat yield. On the other hand, Amin and Baque (2020) observed that application of organic manure could reduce the impact of drought on wheat irrespective of growth stages. They also observed that application of cowdung (10 t ha^{-1}) was found more effective to combat drought impact at booting stage of wheat. As such, this research work was designed to determine the effect of different levels of cowdung on mitigation of water deficit effect on wheat.

Materials and Methods

Apot experiment was conducted at the net house of the department of Agronomy, Sher-e-Bangla Agricultural University (SAU), Dhaka-1207, during the period of November 2018 to March 2019. The experimental field was located at 24°09′ N latitude and 90°26′ E longitude at a height of 8.5 m above the sea level (FAO/UNDP, 1988). The soil of the experimental site was clay loam belonging to the "Madhupur Tract" under AEZ 28. Two factors experiment were- factor A: Five levels of cowdung, viz.i) C_0= Control (No cowdung), C_1= 25% less cowdung of recommended dose, C_2 = Recommended dose of cowdung, C_3 = 25% higher cowdung of recommended dose and C_4 = 50% higher cowdung of recommended dose, and factor B: four levels of water deficit at, i) D_0 = Control (No water deficit), D_1= Crown root initiation stage (20-19 DAS), D_2 = Booting stage (45-54 DAS) and D_3= Anthesis stage (55-64 DAS) (Amin and Baque, 2020). The experiment was laid out in a Factorial R and omized Complete Block Design with three replications. The test crop variety of wheat was BARI Gom28. Sixty earthen pots measuring 22 cm diameter and 18 cm height was fill-up with 20 kg of soil. Urea, TSP, MoP, Gypsum, Zincoxide and Boric acid were used at the rate of 200, 72, 66, 110, 4 and 5 kg ha^{-1}, respectively (BRRI, 2006 / FRG, 2018), which were 2.00, 0.72, 0.66, 1.10, 0.04 and 0.05 g pot^{-1}, respectively and mixed all of them except urea with the soil before fill-up the pot. Urea was applied in three equal installments at pot filling, 21 DAS and 55 DAS. Recommended dose of cowdung was 10 t ha^{-1} and was applied as per treatment. Seeds of wheat variety BARI Gom28 were collected from Bangladesh Agriculture Research Institute (BARI), Joydebpur, Gazipur. Before sowing, seeds were treated with Provex 200EC @ 2.5 g powder for kg^{-1} seed. Fifteen seeds were sown in each pot on 21st November 2018. After sowing, the seeds were covered with soil and lightly pressed by hand. For assessment, five plants were kept in each pot after 14 DAS. Different intercultural operations were done to ensure normal growth and development of the crop except irrigation. Irrigation was applied as per need of treatment of the experiment where irrigation was not applied during water deficit imposition period(s) treatments. On the basis of physiological maturity, the crop was harvested from 4-10 March, 2019. Data on different crop characters, yield attributes and yield were collected from the harvested five plants from each pot. Post-harvest operations like- threshing, cleaning and drying of grains were done separately for each treatment. Properly dried grain and straw were weighed and converted into g $plant^{-1}$ basis. The collected data of each pot were statistically analyzed by using the computer-

based software Statistics 10. Mean difference among the treatments were compared with Duncan's Multiple Range Test (DMRT) test at 5 % level of significance.

Results and Discussion

The result reveled that different cowdung treatment varied significantly with respect to yield and yield contributing characters of wheat (Table 1 and Table 2). The yield advantages of 0.78, 0.48, 0.38 and 0.13g plant^{-1} for C_4 (50% higher cowdung of recommended dose) applied pot over C_0 (No cowdung), C_1 (25% less cowdung of recommended dose), C_2 (Recommended dose of cowdung) and C_3 (25% higher cowdung of recommended dose, respectively) applied pot was found possibly due to maximum effective tillers plant^{-1} (5.25), spike length (10.39cm), spikelets spike^{-1} (15.72), grains spike^{-1} (32.56), grains spikelet^{-1} (2.07), weight of 1000grains (47.32 g), straw yield (6.47 g plant^{-1}), biological yield (11.39 g plant^{-1}) and harvest index (44.08%) in the C_4 applied treatment. On the other hand, C_3 treatment gave statistically similar yield and yield attributes with C_4 treatment in some traits. The result agreed with the findings of Amin and Baque (2020), Hammad *et al.* (2011) and Ibrahim *et al.* (2008) that organic manure increased wheat yield over control. According to Uyanoz *et al.* (2006) yield attributes of wheat improve with organic manure which corroborates with the present results.

Table 1. Effect of different levels of cowdung on plant characters and yield attributes of wheat

Cowdung dose	Plant height (cm)	Effective tillers plant^{-1} (no.)	Spike length (cm)	Spikelets spike^{-1} (no.)	Grains spike^{-1} (no.)	Grains spikelet^{-1} (no.)	Weight of 1000 grains (g)
C_0	66.65 c	2.94 e	9.48 c	14.07 b	22.36 d	1.58 c	39.51 c
C_1	68.07 bc	3.56 d	9.68 bc	14.25 b	26.25 c	1.84 b	41.86 b
C_2	68.08 bc	3.90 c	9.82 bc	14.48 b	28.78 b	1.99 ab	42.85 b
C_3	69.97 ab	4.68 b	10.17 ab	15.50 a	31.36 a	2.02 ab	46.58 a
C_4	72.14 a	5.25 a	10.39 a	15.72 a	32.56 a	2.07 a	47.32 a
SE	1.33	0.13	0.27	0.34	0.71	0.08	1.00
CV (%)	4.71	8.07	6.78	5.58	6.18	10.87	5.62

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 5% level of significance by DMRT.
Here: C_0= Control (No cowdung), C_1= 25% less cowdung of recommended dose, C_2 = Recommended dose of cowdung, C_3 = 25% higher cowdung of recommended dose and C_4 = 50% higher cowdung of recommended dose

Table 2. Effect of different levels of cowdung on yield and harvest index of wheat

Cowdung dose	Grain yield plant^{-1} (g)	Straw yield plant^{-1} (g)	Biological yield plant^{-1} (g)	Harvest index (%)
C_0	4.34 d	5.90 b	10.24 b	42.29
C_1	4.64 c	6.08 ab	10.72 b	43.21
C_2	4.76 bc	6.17 ab	10.79 b	43.47
C_3	4.99 ab	6.50 a	11.48 a	43.37
C_4	5.12 a	6.47 a	11.59 a	44.08
SE	0.126	0.247	0.294	NS
CV (%)	6.45	9.72	6.56	5.84

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 5% level of significanc by DMRT.
Here: C_0= Control (No cowdung), C_1= 25% less cowdung of recommended dose, C_2 = Recommended dose of cowdung, C_3 = 25% higher cowdung of recommended dose and C_4 = 50% higher cowdung of recommended dose, and NS = Not significant

Significant difference existed among the water deficit-imposed treatments, the control plants D_0 and D_2 showed maximum statistically similar grain yield, spike length, spikelets spike^{-1}, weight of 1000 grains and harvest index (Table 3 and Table 4). Without drought treatment was superior by producing 34.41 and 19.78% higher yield over D_3 and D_1 treatments, respectively. On the other hand, D_2 treatment was out yielded by producing 29.18 and 15.11% higher yield over D_3 and D_1, respectively. The treatment without drought also produced highest level of tillers plant^{-1}, spikelets spike^{-1}, grains spike^{-1}, straw yield, biological yield and harvest index than drought imposition plants. However, among the drought imposition treatments, D_2gave highest yield and yield attributes than other drought imposition treatments. The present result was confirmatory with the findings of Amin and Baque (2020) and Akram (2011) that drought imposition at different growth stages caused severe reduction in yield and yield components of wheat. Similar result was also observed by Alghabari and Isham (2018) that drought stress affected barley yield through impaired grain development and grain filling duration.

Table 3. Effect of water deficit treatment on plant characters and yield attributes of wheat

Water deficit stage	Plant height (cm)	Effective tillers plant^{-1}	Spike length (cm)	Spikelets spike^{-1}	Grains spike^{-1}	Grains spikelet^{-1}	Weight of 1000 grains (g)
D_0	73.41 a	4.86 a	10.53 a	15.50 a	34.10 a	2.20 a	45.42 a
D_1	70.75 b	3.94 c	9.69 bc	14.75 b	26.08 c	1.76 c	42.87 b
D_2	67.31 c	4.58 b	10.11 ab	15.19ab	30.17 b	1.98 b	45.36 a
D_3	64.46 d	2.88 d	9.29 c	13.84 c	22.70 d	1.62 c	40.84 c
SE	1.19	0.12	0.24	0.30	0.64	0.07	0.89
CV (%)	4.71	8.07	6.78	5.58	6.18	10.87	5.62

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 5% level of significance

Here: D_0 = Control (No water deficit), D_1= Water deficit at crown root initiation stage (20-19 DAS), D_2 = Water deficit atbooting stage (45-54 DAS) and D_3= Water deficit at anthesis stage (55-64 DAS)

Table 4. Effect of water deficit treatment on yield and harvest index of wheat

Water deficit stage	Grain yield plant^{-1} (g)	Straw yield plant^{-1} (g)	Biological yield plant^{-1} (g)	Harvest index (%)
D_0	5.39 a	6.72 a	12.11 a	44.47 a
D_1	4.50 b	6.01 b	10.51 b	42.82 ab
D_2	5.18 a	6.63 a	11.70 a	43.84 ab
D_3	4.01 c	5.53 c	9.54 c	41.99 b
SE	0.11	0.23	0.26	0.92
CV (%)	6.45	9.72	6.56	5.84

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 5% level of significance.

D_0 = Control (No water deficit), D_1= Water deficit at crown root initiation stage (20-19 DAS), D_2 = Water deficit atbooting stage (45-54 DAS) and D_3= Water deficit at anthesis stage (55-64 DAS).

Interaction of cowdung level and water deficit imposition treatments showed significant variation in all the studied parameters (Table 5 and Table 6). The interaction of C_4D_0 and C_3D_0 performed best in respect of grain yield (5.93 and 5.62 g plant^{-1}, respectively) which may be attributed to highest effective tillers plant^{-1}, spike length, spikelets spike^{1}, grains spikelet^{1} and weight of 1000grains in these interactions. On the other hand, interaction of C_3D_2 also showed statistically similar yield (5.48 g ha^{-1}) and yield contributing characters with C_4D_0 and C_3D_0 interactions.

Table 5. Interaction effects of different levels of cowdung and water deficit imposition treatment on plant characters and yield attributes of wheat

Interaction	Plant height (cm)	Effective tillers plant^{-1}	Spike length (cm)	Spikelets spike^{-1}	Grains spike^{-1}	Grains spikelet^{-1}	Weight of 1000- grain (g)
C_0D_0	71.67 a-d	3.81 fg	10.26 a-g	14.71 c-h	26.99 f-h	1.83 e-h	42.63 ef
C_0D_1	68.67 c-g	2.22 k	9.16 g-i	13.73 g-i	21.18 j	1.54 h-i	38.04 g
C_0D_2	64.85 gh	3.43 gh	9.47 c-i	14.42 d-i	24.55 hi	1.70 gh	40.35 fg
C_0D_3	61.40 h	2.31 jk	9.01 i	13.42 hi	16.72 k	1.25 i	37.03 g
C_1D_0	73.38 a-d	4.08 d-f	10.47 a-d	15.01 a-g	32.70 cd	2.18 a-d	45.19 c-e
C_1D_1	70.91 a-f	3.77 fg	9.30 e-i	14.23 f-i	23.51 ij	1.65 gh	40.15 fg
C_1D_2	65.92 f-h	3.88 fg	9.83 b-i	14.63 c-h	27.50 fg	1.88 d-g	44.05 d-f
C_1D_3	62.08 h	2.52 i-j	9.10 hi	13.11 i0	21.30 j	1.62 gh	38.04 g
C_2D_0	72.27 a-d	4.58 d	10.16 a-h	15.24 a-f	35.62 b	2.34 ab	37.97 g
C_2D_1	69.38 b-g	4.02 ef	9.64 c-i	14.37 e-i	26.49 f-h	1.84 e-h	43.75 d-f
C_2D_2	66.11 e-h	4.16 d-f	10.03 b-i	14.86 b-g	30.52 de	2.05 b-f	45.75 b-e
C_2D_3	64.54 gh	2.83 ij	9.43 d-i	13.45 hi	22.50 ij	1.67 gh	43.94 d-f
C_3D_0	74.33 ab	5.67 a-c	10.57 a-c	16.22 ab	36.07 b	2.22 a-c	49.63 ab
C_3D_1	71.12 a-f	4.45 de	10.06 b-i	15.66 a-c	30.54 de	1.95 c-g	45.44 c-e
C_3D_2	68.23 d-g	5.53 bc	10.40 a-e	15.9 a-c	33.78 bc	2.12 a-e	48.41 a-c
C_3D_3	66.21 e-h	3.06 hi	9.63 c-i	14.50 d-h	25.06 g-i	1.73 f-h	42.82 ef
C_4D_0	75.42 a	6.16 a	11.20 a	16.33 a	39.13 a	2.40 a	51.67 a
C_4D_1	73.68 a-c	5.25 c	10.30 a-f	15.76 a-d	28.70 ef	1.82 e-h	46.99b-d
C_4D_2	71.42 a-e	5.91 ab	10.80 ab	16.10 ab	34.48 bc	2.14 a-e	48.22 a-c
C_4D_3	68.05 d-g	3.66 fg	9.27 f-i	14.70 c-h	27.93 e-g	1.90 e-h	42.38 ef
SE	2.65	0.27	0.55	0.67	1.43	0.17	2.00
CV (%)	4.71	8.07	6.78	5.58	6.18	10.87	5.62

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 5% level of significance by DMRT.

Here: C_0= Control (No cowdung), C_1= 25% less cowdung of recommended dose, C_2 = Recommended dose of cowdung, C_3 = 25% higher cowdung of recommended dose and C_4 = 50% higher cowdung of recommended dose; D_0 = Control (No water deficit), D_1= Water deficit at crown root initiation stage (20-19 DAS), D_2 = Water deficit atbooting stage (45-54 DAS) and D_3= Water deficit at anthesis stage (55-64 DAS).

Table 6. Interaction effects of different levels of cowdung and water deficit imposition treatment on yield and harvest index of wheat

Interaction	Grain yield plant^{-1} (g)	Straw yield plant^{-1} (g)	Biological yield plant^{-1} (g)	Harvest index (%)
C_0D_0	4.82 d-g	6.36 a-e	11.18 c-f	43.11 ab
C_0D_1	4.13 h-j	5.70 d-f	9.83 g-i	42.01 ab
C_0D_2	4.91 d-f	6.44 a-d	11.35 c-f	43.26 ab
C_0D_3	3.51 k	5.10 f	8.61 j	40.77 b
C_1D_0	5.13 b-d	6.48 a-d	11.61 b-e	44.19 ab
C_1D_1	4.50 f-i	5.97 b-f	10.47 e-h	42.98 ab
C_1D_2	5.07 c-e	6.45 a-d	11.52 b-e	44.00 ab
C_1D_3	3.86 jk	5.40 ef	9.26 ij	41.67 b
C_2D_0	5.45 a-c	6.76 a-c	12.21 a-c	44.64 ab
C_2D_1	4.41 f-i	5.88 c-f	10.29 f-i	42.86 ab
C_2D_2	5.12 b-e	6.47 a-d	11.59 b-e	44.18 ab
C_2D_3	4.07 ij	5.58 d-f	9.65 h-j	42.18 ab
C_3D_0	5.62 ab	7.08 a	12.70 ab	44.25 ab
C_3D_1	4.62 e-h	6.10 a-e	10.72 e-h	43.10 ab
C_3D_2	5.48 a-c	7.06 a	12.54 ab	43.70 ab
C_3D_3	4.23 h-j	5.74 d-f	9.97 g-i	42.43 ab
C_4D_0	5.93 a	6.91 ab	12.84 a	46.18 a
C_4D_1	4.86 d-g	6.40 a-d	11.26 c-f	43.16 ab
C_4D_2	5.32 b-d	6.75 a-c	12.07 a-d	44.08 ab
C_4D_3	4.37 g-i	5.82 c-f	10.19 f-i	42.89 ab
SE	**0.25**	**0.49**	**0.59**	**2.06**
CV (%)	**6.45**	**9.72**	**6.56**	**5.84**

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s)differ significantly at 5% level of significance by DMRT.
Here: C_0= Control (No cowdung), C_1= 25% less cowdung of recommended dose, C_2 = Recommended dose of cowdung, C_3 = 25% higher cowdung of recommended dose and C_4 = 50% higher cowdung of recommended dose; D_0 = Control (No water deficit), D_1= Water deficit at crown root initiation stage (20-19 DAS), D_2 = Water deficit atbooting stage (45-54 DAS) and D_3= Water deficit at anthesis stage (55-64 DAS).

Conclusion

It isconcluded from the result that although both of 50% and 25% higher cowdung than recommended dose gave the highest yield but 25% higher cowdung than recommended dose (as it save 25% cowdung) may be suggested to overcome yield loss due to water deficit conditionat booting stage of wheat (D_2).

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