Global Advanced Research Journal of Agricultural Science (ISSN: 2315-5094) Vol. 4(5) pp. 235-240, May, 2015.
Available online http://garj.org/garjas/index.htm

Full Length Research Paper

A study to analyze the real efficiency of Distillery Spent Wash (DSW) in comparison of NPK (standard chemical fertilizer) at seedling stage of wheat (*Triticum aestivum L.*)

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Accepted 27 May, 2015

It is generally observed that the prices of the synthetic chemical fertilizers are increasing unexpectedly. Therefore, to bring the best alternative solution of that problem, a series of experiments has been started in which distillery spent wash (DSW) as well as different levels of NPK (standard chemical fertilizer) have been brought under study. In this study distillery spent wash at 8.0%+ 92% water and NPK 10 g L[1](standard chemical fertilizer with 18-23-23%) were applied to observe the performance of wheat at seedling stage 42 days after sowing (DAS). The data of 200 plants were collected at random from each environmental condition, such as, control, DSW treated and NPK treated. The average performance of wheat plants treated with DSW was root length (10.675 cm), shoot height (45 cm), fresh root weight (34.67 g), fresh shoot weight (71.28 g), dry root weight (6.38 g) and shoot dry weight (7.87 g) were recorded. However, these all traits of observations were highest for NPK (standard chemical fertilizer) treated plants.

Keywords: Wheat, distillery spent wash, root, shoot, seedlings.

Abbreviations: cm= Centimetre **g**= Gram

INTRODUCTION

All over the world the consumption of fertilizer is greatly correlated with overall economic growth of the country. The consumption of fertilizer in the world increased at higher rates from 1950 to 1990. The rapid and continuous increase in world population has caused an increase in the demand of the food. Therefore, three ways could be applied to overcome this issue, these are, new lands should be brought under cultivation, use of high yielding

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Table 1: Some important properties of spent wash are shown in the following table

pH	3.9 – 4.3
EC (dS/m)	30.5 – 45.2
Biological Oxygen demand	46100 – 96000
Chemical oxygen demand	104000 – 134400
Total dissolved solids	79000 – 87990
Nitrogen	1660 – 4200
Phosphorous	225 – 3038
Potassium	9600– 17475
Calcium	2050 – 7000
Magnesium	1715 – 2100
Sodium	492 – 670
Sulphate	3240 – 3425
Chloride	7238 – 42096
Zinc	3.5 – 10.4
Copper	0.4 – 2.1
Manganese	4.6 – 5.1
Gibberellic acid	3246 – 4943
Indole acetic acid	25 – 61

***All values in in mg/L unless otherwise given above.**
Sources: Rajukkannu and Manickam (1997); Valliappan (1998); Murugaragavan (2002)

seeds and use of fertilizers to improve soil fertility (Pakistan Fertilizer Sector Review, IGI Securities, 2007).

Sugarcane is one of the most important cash crops of Pakistan. It is mainly grown for manufacturing the sugar and sugar-related products. (Bayer Crop Science, 2014). Besides sugar and alcohol, sugar mills generate many by-products and waste materials. Distillery spent wash is one of them and it is surplus residual liquid waste generated during alcohol manufacture (Sarayu *et al.,* 2009). The spent wash is acidic (pH 3.94 to 4.30) and full with organic and inorganic salts, consequential in high EC (30-45 dS/m). As spent wash is a plant-origin, so, it contains substantial quantity of plant nutrients and organic matter (Table 1). As spent wash contains essential plant-nutrients, so, it can effectively be utilized as a source of plant nutrients as well as a soil amendment. Recently, the presence of appreciable amounts of plant growth promoters' viz., gibberellic acid (GA) and indole acetic acid (IAA) have also been detected from spent wash which further increases the nutritional value of spent wash (Murugaragavan, 2002). The high concentration of calcium (Ca) (2050 – 7000 mg/l) in spent wash might have the ability to reclaim the sodic soils similar to that of gypsum because it also contains the calcium. The effects could be ascribed to the nutrients and the growth promoters like GA and IAA present in the spent wash. Among the plant nutrients, potassium (K) is found in higher amounts followed by nitrogen (N) and phosphorus (P). The activities of enzymes and microbes were also enhanced in soils amended with the spent wash. As much as spent wash is concerned, scientific experimentation technologies are required for effective utilization of this valuable resource in agriculture field which is safe to environment (Santiago *et al*., 2004). The application of spent wash to the lands is not only its proper utilization for agricultural production but it is also beneficial for control of water pollution. Spent wash contains great amount of essential nutrients for plants, such as; calcium, copper, iron, manganese, nitrogen, phosphorus, potassium, sulphur and zinc (Suganya and Ranhjannan, 2009).

Keeping in view the importance of distillery spent wash a series of experiments has been started to assess the impact of distillery spent wash (DSW) at seedling stage of wheat (Triticum aestivum L.) with comparison to NPK (standard chemical fertilizer).

MATERIALS AND METHODS

A series of experiments was conducted in the seed testing laboratory of department of Agronomy at Sindh Agriculture University, Tandojam, Pakistan. The distillery spent wash (DSW) was obtained from Unicol ltd. at Mirpur Khas Sugar mills ltd. Sindh, Pakistan. The following methodology was applied.

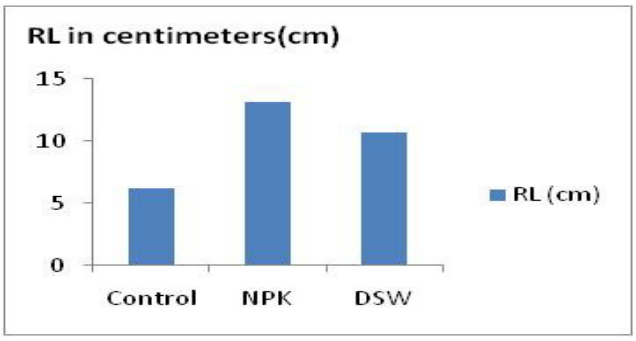
The wheat seed of TJ-83 variety was surface sterilized with 1% hypochlorite solution for 10 minutes and rinsed well with distilled water. Then seeds were soaked in

distilled water in the dark at 30 °C for 72 hours. The most uniform well-emerged seeds from the whole amount of seed were directly sown into perforated Styrofoam sheets covered with nylon net at the bottom which were left floated on simple water filled in plastic containers. Each plastic container under each experimental condition (control, DSW and NPK treated) contained 05 liters of simple water. The Styrofoam sheets were allowed to float on simple water up to 7 days without addition of any treatment and then transferred to distillery spent wash (DSW) treated at the rate of 8%+ 92% water, NPK (standard chemical fertilizers) with 18-23-18% (at the rate of 09 grams (g) of nitrogen+11 g of phosphorus+9 g of potassium) for 35 days and untreated control (as check). The pH of the solution was adjusted to 5.0 with 1 N NaOH/HCl on alternative day. The solution was renewed every fifth day. The experimental materials were laid out in two replications for all treatments (control, DSW treated and NPK treated) under laboratory conditions at around 32/25 °C in day/night, 70-75% of relative humidity and average 12 hours photoperiod maintained through artificial lights. Then, root and shoot length (cm), root and shoot fresh weight (g) of 200 plants from each environmental condition was recorded randomly after 35 days of the treatments' application. Then the samples were kept in oven for 72 hours (3days) at maximum 65°C. Finally, dry weight (g) of root and shoot was recorded. On the basis of root-shoot length, root-shoot fresh weight and root-shoot dry weight, the impact of DSW was compared with NPK (standard chemical fertilizers).

RESULTS

Root length (RL)

The phenotypic performance of wheat seedlings for root length in NPK and DSW is shown in figure 1. The figure revealed that the average root length under controlled conditions (untreated plants) was predictably and lowest of all treated plants at 6.26 cm. However, in NPK and DSW were 13.2 cm and 10.675 cm respectively. In this way, the DSW treated plants lost 19.128% root length as compared to NPK treated plants.



*RL= Root length, *DSW= Distillery spent wash

Figure1. Root length (RL) of wheat seedlings under control, NPK and DSW treatments

Shoot height (SH)

The results for shoot height of wheat for all untreated and treated plants are presented in figure2. The figure 2 showed that shoot height of untreated plants under control conditions were predictably lowest of all plants at 19.4 cm. But the shoot height of plants treated with DSP reached at 45 cm as compared to plants treated with NPK (standard chemical fertilizers) which could grow at 55 cm. In this way, NPK treated plants gained 18.18% higher shoot height than DSW treated plants.

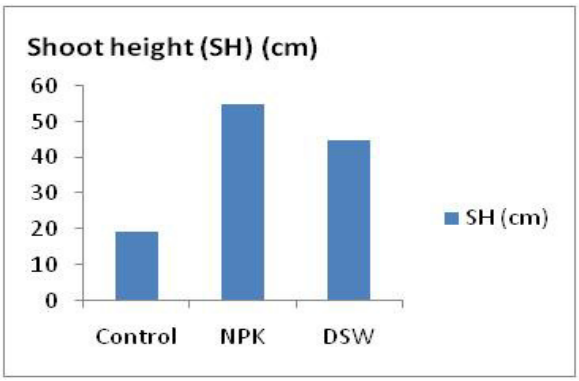


Figure2. Shoot height (SH) of wheat seedlings under control, NPK and DSW Treated conditions.

Fresh root weight (FRW)

The data for fresh root weight (FRW) is presented in figure3. It revealed that fresh root weight (19.88 g) of plants under control condition was predictably and significantly lowest of all experimental conditions. However, the application of NPK (standard chemical fertilizer) resulted highest fresh root weight at 40.45 (g) which was 13.67% greater than DSW treated plants, because their FRW was 34.67 (g).

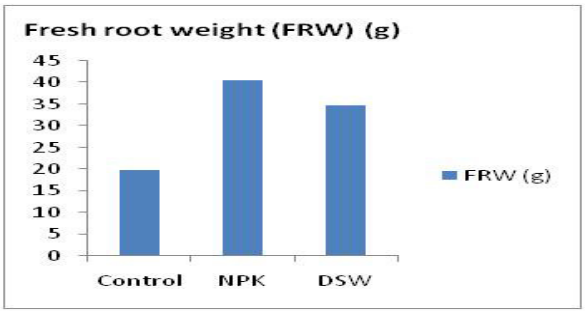


Figure3. Fresh root weight (FRW) (g) of wheat seedlings under control, NPK and DSW treated conditions

Fresh shoot weight (FSW)

The fresh shoot weight (FSW) of the untreated and treated seedlings of wheat is shown in figure 4. It showed that plants under control conditions got lowest fresh shoot weight at 41.432 (g) as compared to all other environmental conditions of the study. Whereas, NPK treated plants got highest FSW at 83.33 (g) which was 14.46% more than DSW treated plants which got FSW at 71.28 (g).

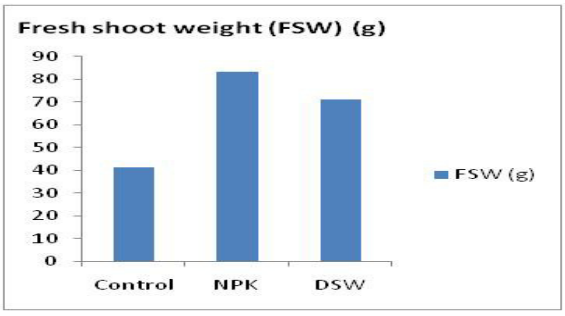


Figure4. Fresh shoot weight (FSW) (g) of wheat seedlings under control, NPK and DSW treated conditions.

Dry root weight (DRW)

The dry root weight of wheat seedlings under control, NPK and DSW treated environment is shown in figure 5. It showed that seedlings under control condition (untreated) got lowest dry root weight at 4.14 (g) which was significantly lowest DRW of all other environmental conditions. The NPK treated plants obtained highest DRW at 8.33 (g) which was 23.41% higher than DSW treated seedlings. The DRW of DSW treated seedlings was 6.38 (g).

Figure 5. Dry root weight (DRW) (g) of wheat seedlings under control, NPK and DSW treated conditions.

Dry shoot weight (DSW)

The dry shoot weight (DSW) (g) of wheat seedlings under control, NPK and DSW treated conditions is shown in figure 6. It revealed that plants under control conditions got significantly lowest DSW at 5.07 (g). The NPK treated plants showed highest DSW at 9.73 (g), which was 19.12% greater than DSW treated plants. However, the DSW of DSW treated plants was 7.87 (g).

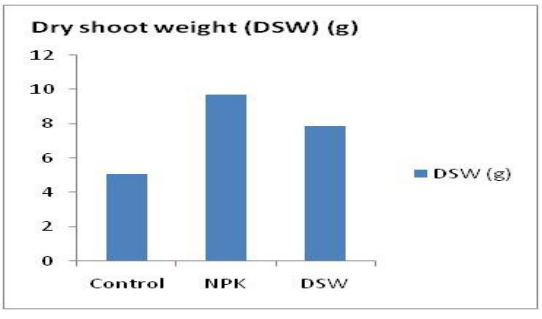


Figure 6. Dry shoot weight (DSW) (g) of wheat seedlings under control, NPK and DSW treated conditions.

DISCUSSION

The prices of chemical fertilizers have become one of the burning issues for the farming community of the world. The chemical fertilizers have been widely used to increase the soil fertility through addition of essential nutrients such as, NPK for the crop growth and development. To find out the substitute of these expensive chemical fertilizers, and proper utilization of distillery spent wash a series of studies on performance of different crop plants under proposed dose of applied NPK and different concentrations of distillery spent wash has been conducted. This study is one of them. The overall performance of wheat for all measured traits of evaluation under proposed dose of NPK was comparatively better than distillery spent wash treated plants. The different studies showed that besides gibberellic acid and indole acetic acid (IAA) distillery spent wash also contains 13 essential elements (shown above in table 1) which exert their highly important effects on crops for their proper growth and development. This study revealed that the plants which were added proposed dose of NPK performed best of all other conditions. However, controlled plants (zero application of both NPK and distillery spent wash) showed predictably lowest values for all traits such as, root-shoot length, root-shoot fresh weight and root-shoot dry weight. On the one side due to deficiency of NPK the growth of these untreated seedlings was significantly very poor and pale (yellow) in color. And on the other side, these seedlings were weak, so, could not stand straight upward for longer period of time, so, these mostly fell down. The roots of these untreated seedlings were also poorly structured. These findings are in agreement with those of Laghari *et al*., (2010) and Youssef *et al*.,(2013) who also recorded poor performance of wheat crop at zero application of NPK for different growth and yield parameters. Whereas, all other treated plants with NPK or distillery spent wash had higher trends for all traits of measurement. These findings are in agreement with those of Mohamed Hussein and Ashok (2014), who also noted that the biomass of the plants which received NPK was higher than the plants which were not given NPK fertilizers. Similar results for comparatively better performance of crop plants with applied NPK than zero NPK application have been reported by Singh and Balyan (2000), Laghari *et al*., (2010), Youssef et al., (2013); and Imran *et al*., (2014). Not only in our this study the performance of wheat seedlings was better at the application of proposed dose of NPK, but Sharma *et al*. (2000) also observed higher dry matter and more yield of wheat with the application of NPK than control. Due to easily available form of NPK in hydroponic culture solution wheat performed better than all other experimental conditions. Our findings for role of NPK in better performance of wheat for all traits of measurement also resembled with that of Hasnabade *et al*. (1990). In case of distillery spent wash study, our recorded results were predictably higher than control as check and less than NPK treated plants. These findings are in agreement with those of Aijaz and Ayaz (2015). Radha (2011) who also recorded similar decreasing trends of traits under different concentrations of crude spent wash CSW (10, 100 ml kg1 soil) and distillery spent wash DSW (100 ml kg1 soil). In another study by Gahlot *et al*. (2011) observed that as the concentrations of spent wash increased from 2.5% to 20%, so the root weight was decreased from 0.895 g plant^{1} to 0.035 g plant^{1} and at the same concentrations shoot dry weight (SDW) also decreased from 0.668 g plant^{1} to 0.441 g plant^{1}. These all studies suggested that as the concentration of distillery spent wash increased, so, the performance of crop plants decreased than plants treated with proposed dose of NPK (standard chemical fertilizer). Therefore, some more studies will be conducted on most suitable concentrations of distillery spent wash. In these upcoming studies the concentration of distillery spent wash would be used less than 08% with more than 92% of water or more than 08% with less than 92% of water. There is a great hope that after conducting upcoming studies on reduced/increased concentrations of distillery spent wash; we will be able to recommend the proper concentration of the distillery spent wash to the farmers as it could be utilized as a productive as well as cheapest substitute of chemical fertilizers.

CONCLUSION

It is concluded that the general growth of wheat crop at its seedling stage was best when proposed dose of NPK was applied as compared to all other DSW treated and untreated (control) plants. However, the data for response of wheat to distillery spent wash+ water at the rate of (08%+92%) has also opened an innovative way to utilize this concentration of DSW with water in the areas where DSW is easily available as compared to NPK (standard chemical fertilizers). Therefore, DSW at lower concentration (08%) was only useful for getting better trends of evaluation of the wheat seedlings. It is therefore suggested that until and unless we could reach at the final decision for the proper utilization of distillery spent wash at proper rate for getting higher grain yield, farmers must utilize synthetic fertilizers for increasing soil fertility and grain yield of wheat.

ACKNOWLEDGEMENT

The authors are highly thankful to Unicol ltd. at Mirpur Khas sugars mills ltd. Sindh, Pakistan for supply of Distillery Spent Wash.

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