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IMPACT OF SPLIT APPLICATION OF UREA ON THE MANAGEMENT OF WHEAT APHID

Muhammad Asghar[1*], Mirza Muhammad Qadeer Baig[1], Sanaullalh Chaudhary[1], Masood Qadir Waqar[2] and Muhammad Anjum Ali[3]

[1]Adaptive Research Farm, Gujranwala; [2]Directorate of Agriculture (A.R.) Punjab-Lahore;
[3]Directorate General of Agriculture (Ext. & A.R.) Punjab Lahore
E-mail: Miang786@yahoo.com (**Corresponding Author*)

Abstract: Due to imbalance use of fertilizer aphid attack on wheat crop is increasing. A field study was conducted to evaluate the impact of split application of nitrogenous fertilizer on aphid infestation and grain yield of wheat crop according to randomized complete block design with three replications at Adaptive Research Farm, Gujranwala during the years 2012-13, 2013-2014 and 2014-15. The nitrogen was applied in four different treatments i.e. 1/3 Nitrogen at sowing, 1/3 with first irrigation and remaining 1/3 at second irrigation (T1), all nitrogen at sowing (T2), ½ nitrogen at sowing and ½ nitrogen at the time of 1st irrigation (T3), ¼ nitrogen at sowing+ ¼ nitrogen with 1st irrigation+ ¼ nitrogen with 2nd irrigation + ¼ nitrogen at 3rd irrigation (T4). Aphid population per tiller during the year 2012-13, 2013-14 and 2014-15 was less in two split T3 (7.60, 2.23 and 2.30) as compared to T1 (9.63, 3.13 and 2.60) and T4 (4.66, 5.46 and 4.67). Whereas maximum yield of wheat i.e 2.98 and 3.98 t ha^{-1} during year 2013 and 2014 was recorded in T2. This study will be helpful in managing aphid population through split application of nitrogenous fertilizer.
Keywords: Nitrogen, split application, aphid, wheat.

Introduction

Wheat (*Triticum aestivum* L.) is an important field crop that plays an important role in the economic stability of Pakistan (Anwar *et al*., 2009). Pakistan lies in the top ten wheat producing countries of the world and ranks at ninth in terms of area and eighth in terms of production (Hussain *et al*., 2010). However, the average yield of wheat is lower than the developed countries. In most wheat growing areas, application of insufficient essential nutrients at appropriate stages limit potential yields (Ahmad and Muhammad, 1998). Furthermore a range of insect pests notably aphids (Aphididae: Homoptera), attack the wheat crop. Over the past few years, their population has increased in Pakistan and has attained pest proportions (Aheer *et al.,* 2008). Aphids can cause direct yield losses of 35% to 40% by sucking the sap of infested plant and indirect losses 20% to 80% by transmitting viral and fungal diseases (Aslam *et al.,* 2005). Aphids suck sap that results in curling, chlorosis, distortion of leaves and stunted growth (Kindler *et al*., 1995; Akhter and AKhaliq, 2003). Its

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attack also prevents the production of chlorophyll which results in delayed head emergence causing improper maturity of grains (Wratten and Redhead, 1976).

Wheat yield as well as production experienced substantial fluctuations during the recent years, only because natural population of predators and parasitoids failed to keep aphid population to acceptable limits. This natural balance seems to be disturbed largely due to extensive and indiscriminate use of non-selective pesticides on various crops. Therefore, it is imperative to think of ways and means to resolve the issue (Farooq *et al*., 2011). There is a general perception that imbalanced and excessive doses of nitrogenous fertilizers encourages heavy infestation of aphid on wheat crop and a positive correlation between nitrogen doses and aphid population has been found (Tetarwal *et al*., 2012). Increasing level of nitrogen fertilizer application promotes the occurrence of herbivorous insect pest and hence crop damage (Douglas, 1993; Bi *et al*., 2001; Ge *et al*., 2003). Plants nutritional status and defense systems that directly act on herbivores are altered by nitrogen fertilizer application (Prudic *et al*., 2005).

Therefore, present study was planned and executed under field conditions to evaluate the effects of timing of nitrogen fertlilizer application on the incidence of aphids as well as the growth and yield performance of wheat. An effort was made to make a recommendation for aphid management through an effective strategy for fertilizer application.

Materials and Methods

The study was conducted to evaluate the effect of split application of nitrogen fertilizer on wheat aphid infestation and yield of wheat crop under the field condition at Adaptive Research Farm Gujranwala during the years 2012-13, 2013-2014 and 2014-1015. The experiment was designed according to randomized complete block design with three replications. Size of each experimental plot was measured as 19 x 70 ft.

Wheat variety Faisalabad 2008 was sown with the help of Rabi drill by using recommended seed rate of 125 Kg ha^{-1}. Nitrogen in the form of urea was applied at the time of sowing and irrigation. All phosphatic and potassium fertilizer were applied in the form of Diammonium Phosphate (DAP) and Sulphate of Potash (SOP) respectively at the time of sowing. Nitrogen was applied in four different treatments i.e 1/3 Nitrogen at sowing, 1/3 with first irrigation and remaining 1/3 at second irrigation (T1), all nitrogen at sowing (T2), ½ nitrogen at sowing and ½ nitrogen at 1st irrigation (T3), ¼ nitrogen at sowing+ ¼ nitrogen with 1st irrigation+ ¼ nitrogen with 2nd irrigation + ¼ nitrogen at 3rd irrigation. Rainfall, maximum and minimum temperature was recorded during crop season of wheat. All other agronomic practices were

kept similar. Aphid infestation on tillers and spikes was recorded from the ten different spots from all treatments and replication after ten days interval after the appearance of aphid.

Wheat crop was harvested during last week of April during the three seasons and yield data from three randomly selected spots of one meter square were taken from each experimental plot. Electronic weighing balance was used to measure 1000 grain weight. Collected data were analyzed statistically using ANOVA technique and the significant means were separated by the LSD test (Steel *et al*., 1997).

Results and discussions

Maximum aphids population per tiller (6.98, 3.88 and 2.89) was recorded at maximum and minimum temperature (13.7 & 26 ^{0}c), 12 & 28 ^{0}c) and (14.2 & 26 ^{0}c) on March 20 during the year 2013, 2014 and 2015 respectively as shown in figure 1. However declining trend in aphid population was observed with the increase in temperature. Rainfall also depicted a declining trend in aphid population. Such peak periods of occurrence of aphids in wheat at moderate temperature have also been reported earlier (Aheer *et al*., 1994; Aheer *et al*., 2006). Statistical analysis ($p<0.05$) showed that aphid population per tiller during the year 2012-13, 2013-14 and 2014-15 was less where N was applied in two splits (7.60, 2.23 and 2.30) as compared to three (9.63, 3.13 and 2.60) and four splits(4.66, 5.46 and 4.67) splits as shown in table 1. However after 10 days interval aphid population was reduced (table 2). During year 2012-13 after 10 days interval aphid population was statistically non significant. However, aphid population per tiller during year 2013-14 and 2014-15 was less when nitrogen was applied in two splits (0.90 and 0.80) as compared to three (1.22 and 1.03) and four splits (2.07 and 1.53) respectively. The split application of urea fertilizer results in greenish crop but also attract the sucking pest species which were reasons of the loss of quantity and quality of grains. The present study depicted low pest population at minimum less split application of urea fertilizer while more splits increase the aphid population. This study also agreed with previous findings by Ramzan *et al*. (1992) who stated that high infestation of pest is correlated with the high use of nitrogenous fertilizers. Split applications of nitrogen should be applied only when it is absolutely required and suggest it as the most appropriate and successful strategy of pest management. The same statement was also stated by Ahmad *et al*. (2007) that the excessive dose of nitrogen fertilizer may produce lush green plants, which attract pest infestation; moreover higher doses of fertilizer also affect the crop maturity. The significant increase in the incidence of aphids was recorded with increasing application of nitrogenous fertilizers (Barros *et al*., 2004; Slman, 2002; Gaur and Sharma, 2004).

The results regarding 1000 grain weight during year 2012-13 were non significant. 1000 grain weight was highest i.e 41.33 and 38.66 gram with nitrogen in two splits i.e one at the time of sowing and another at the time of first irrigation during the year 2013-14 and 2014-15 respectively (table 3). This was followed by three (39.66 and 37g) and four (40.33 and 36.33g) split applications of urea. However 1000 grain weight was found to be minimum 37.33 and 34.33 gram when all nitrogen was applied at the time of sowing. According to Wagan *et al*. (2015) maximum use of nitrogen fertilizer results in greenish wheat crop but it also magnetize the pest which may be the reason of the loss of grain weight.

Similarly statistical analysis depicted non significant results regarding yield of wheat during year 2012-13. However, maximum yield of wheat i.e 2.98 and 3.98 t ha^{-1} during year 2013-14 and 2014-15 respectively was recorded where urea was applied in two splits i.e half at sowing time and another half with first irrigation. In comparison to this application of urea in four (2.90 and 3.74 t ha^{-1}) and three (2.85 and 3.80 t ha^{-1}) splits respectively during year 2013 and 2014 gave less yield (table 4). Wheat yield decreases with increase in number of splits application of nitrogen as according to Singh *et al.* (1995) application of higher doses of nitrogen cause higher aphid population. Ali *et al*. (2013) also reported effect of aphid population on grain yield. Aphid cause damage to wheat every year in different wheat growing areas of the world (Radchenco, 1994).

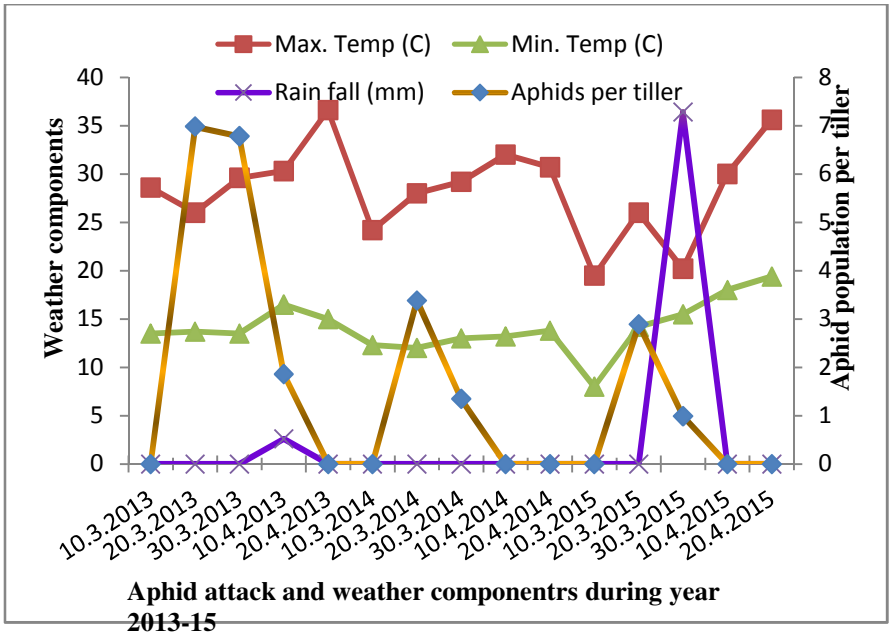

Fig. 1. Effect of weather components on aphid population on wheat

Table 1. Aphid population per tiller as affected by split application of urea

Treatment	Year 2012-13	Year 2013-14	Year 2014-15
T1 (1/3 +1/3+1/3N)	9.63 A	3.13 B	2.60 B
T2(All N at sowing)	6.03 BC	2.70 BC	2.00 B
T3(1/2 N + 1/2N)	7.60 AB	2.23 C	2.30 B
T4 (1/4+1/4+ 1/4+1/4N)	4.66 C	5.46 A	4.67 A
$LSD_{0.05}$	2.162	0.730	0.935

Table 2. Aphid population per tiller affected by split application of urea after 10 days interval

Treatment	Year 2012-13	Year 2013-14	Year 2014-15
T1 (1/3 +1/3+1/3N)	5.30 A	1.22 B	1.03 B
T2(All N at sowing)	7.36 A	1.22 B	0.60 C
T3(1/2 N + 1/2N)	7.03 A	0.90 B	0.80 BC
T4 (1/4+1/4+ 1/4+1/4N)	7.43 A	2.07 A	1.53 A
$LSD_{0.05}$	4.263	0.317	0.417

Table 3. 1000 grain wt (g) affected by split application of urea

Treatments	Year 2012-13	Year 2013-14	Year 2014-15
T1 (1/3 +1/3+1/3N)	34.33 A	39.66 AB	37.00 AB
T2(All N at sowing)	31.33 A	37.33 B	34.33 B
T3(1/2 N + 1/2N)	33.33 A	41.33 A	38.66 A
T4 (1/4+1/4+ 1/4+1/4N)	35.33 A	40.33 A	36.33 AB
$LSD_{0.05}$	5.254	2.378	3.24

Table 4. Yield (tha^{-1}) affected by split application of urea

Treatments	Year 2012-13	Year 2013-14	Year 2014-15
T1 (1/3 +1/3+1/3N)	2.80 A	2.85 A	3.80 B
T2(All N at sowing)	2.69 A	2.54 B	3.58 C
T3(1/2 N + 1/2N)	2.91 A	2.98 A	3.98 A
T4 (1/4+1/4+ 1/4+1/4N)	3.04 A	2.90 A	3.74 BC
$LSD_{0.05}$	0.511	0.184	0.161

Conclusion

Aphid population on wheat crop increased with the increase in number of split application of nitrogenous fertilizer. However among the different split applications, nitrogen in two doses

i.e half at sowing and another half at first irrigation gave better results regarding less attack aphid and also proved helpful to increase in grain yield.

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