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EVALUATING THE THRESHOLD LEVELS OF *NESLIA APICULATA* IN WHEAT AND ITS EFFECTS ON CROP YIELD LOSSES IN SWAT VALLEY OF KHYBER PAKHTUNKHWA

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Abstract

An experiment was conducted during 2012-13 at Agricultural Research Station (ARS) Mingora Swat, KPK, Pakistan to evaluate the effect of different densities of *Neslia apiculata* on grain and total dry matter yield of wheat and total dry matter of *N. apiculata*. Randomized complete block design was used with three replications. Additive design was used where the constant seed rate (125 kg ha^{-1}) of wheat was used. Different densities (5, 10, 15, 20, 25, 30, 35 and 40 m^{-2}) of *N. apiculata* were maintained by using additive design. Data showed that total dry matter and grain yield (kg ha^{-1}) of wheat was decreased with increasing density of *N. apiculata*. At highest density of the weed (40 plants m^{-2}), total dry matter and grain yield of wheat were decreased by more than 60% each. With the increasing density of the weed, its dry matter yield was increased which directly decreased the grain and dry matter yield of wheat. These results indicated that the presence of *N. apiculata* in wheat may cause significant yield reduction if left uncontrolled in wheat fields. Such studies will facilitate the scientists and farmers in decision making processes of weed management and to evaluate the threshold levels for various densities of *N. apiculata* and to figure out yield losses due to *N. apiculata* in wheat. The study is also helpful to find out competition indices of other major weeds in wheat by using ecological designs.

Key words: Wheat, *Neslia apiculata*, Threshold level, Yield loss.

Introduction

A sound knowledge of crop and weed competition is a prerequisite for evolving a suitable weed control strategy. Weeds are unwanted plant species growing in the crops (Dangwal *et al*., 2010), lawns, gardens and waste areas around us. Weeds interfere with the growth and development of crops, vegetables and other valuable plants by limiting the resources and causing considerable losses in the yield of produce (Chaudhri, 1992). Yield loss and harvest problems caused by weeds in wheat will vary depending on the weed species; weed population, time of weed emergence, growing conditions and critical period of weed competition with crop as well as stage of crop when control measures are carried out (Klingman & Ashton, 1982). Weeds are the top most cause of failure of any plant nutrition strategy and is responsible for utilizing more than 50 % of the nutrients which otherwise should have used by the crop, thus decreasing crop yield considerably (Nisar *et al*., 1996). Heavy weeds infestation may cause complete crop failure as in case of some noxious and persistent weeds like *Avena fatua, Silybum marianum, Carthamus oxycantha* and *Cirsium arvense* etc. The cost of removing weeds adds to the cost of crop production, thus the farmers losses a part of their investment and the country suffers a reduction in agricultural commodities and agro-based products. Weeds harm our crops and harbouring of insect pests and plant pathogens and on account of their rapid regenerative abilities, they pose serious problems in our daily life in maintaining our gardens, lawns, roadsides, railway tracts and water channels (Dangwal *et al*., 2010). Decrease in the yield of crops due to weed infestation has been well worked out and documented for most of the major crops (Hussain *et al*., 2004).

The percentage of weeds related losses in our country are significantly higher for various crops including wheat. While in crops with poor canopy coverage and arrested initial growth the losses might be up to 50% or even more like onion (Mahmood & Niaz, 1992). Most of the inputs like water and fertilizer are used and exploited by the more competitive species of plants which are weeds rather than crops for sure in many cases (Nisar *et al*., 1996; Khan *et al*., 2003). Weed crop competition for essential nutrients and the resultant decrease in yield is now well established and is a key to decision making in weed management program for various crops (Bond and Burston, 1996; Reddy *et al*., 2003). It is believed that critical weed competition period in wheat is 30 to 60 days after sowing. After 60 days of sowing, there is no economic benefit to eradicate weeds from wheat crop (Khan *et al*., 2002). The ultimate effect of weed competition is to reduce the growth and yield of the crop, but determining the way in which yield reduction occurs is important in understanding the complex phenomenon of crops and weeds competition. Weed competition has become a major constraint in limiting yield of any crop. This situation is more severe in Pakistan due to unawareness and lack of resources.

Wheat (*Triticum aestivum* L.) is grown in winter throughout the country and requires long days for starting flowering and reproductive growth. In Pakistan, wheat being the staple diet is the most important crop and is cultivated on the largest acreages in almost every part of the country. It contributes 14.4 % to the value added in agriculture and 3 % to GDP and plays a pivotal role in the economy. Still the yield of wheat is very low in our country as compared to advanced countries or even other developing countries of the world. There are several reasons for this lower yield like improper fertilizer use and not taking in to account the nutritional status of our soils (Nisar *et al*., 1996). The present crop-weed competitive studies will facilitate the farmers and researchers in decision making processes of weed management. The main objective of the present study is to figure out yield losses due to *N. apiculata* at different densities in wheat in Swat, Khyber Pakhtunkhwa, Pakistan and to evaluate the threshold level of *N. apiculata* in wheat.

Materials and Methods

The present study was conducted with the aim of finding the effect of different densities of *Neslia apiculata* on total dry matter and grain yield losses of wheat by using additive design at Agriculture Research Station, Mingora- Swat, KPK during October, 2012. The Swat valley is situated in the North of Khyber Pakhtunkhwa. It is the upper valley of the Swat River, which arises from the Hindu Kush range. Mingora is the main town in Swat valley with a 35° North Latitude and 72° and 30° East Longitude, and is enclosed by the sky-high mountains. Its total area is 5,337 km^2. Chitral and Gilgit are situated in the North, Dir in the West and Mardan in the South, while Indus separates it from Hazara in the East.

Seed bed preparation: An additive design experiment was conducted on previously wheat cultivated field. The field was irrigated up to field capacity. Before sowing of wheat and *N. apiculata,* seedbeds were prepared by plowing the experimental plot twice and leveled by using harrow. The rest of agronomic practices were used uniformly for the all the experimental plots. Nitrogen (N) and phosphorus (P) were used as urea and DAP @ 120 and 90 kg ha^{-1}, respectively. Half of the N was applied with P during sowing time while the remaining N was applied with 2nd irrigation after sowing of wheat. All cultural practices were carefully performed during the growing season of the wheat for optimum wheat and *N. apiculata* growth.

Maintaining the density of wheat and *N. apiculata*: As additive design was used therefore, the required densities of *N. apiculata* were properly maintained. Pure stand of wheat and different densities of *N. apiculata* were obtained by thinning their dense population to keep accurate population of *N. apiculata* in each plot to decipher the competitive ability of this weed and ensure availability of nutrients and other useful resources to the desired plants. The weeds other than *N. apiculata* were manually uprooted throughout the growing season on weekly basis or as per need. The data were taken on grain yield of wheat, total dry matter of wheat and total dry matter of *N. apiculata*.

Experimental design: This experiment was laid out in additive design with pure stand of wheat (0) and eight densities of *Neslia apiculata* (5, 10, 15, 20, 25, 30, 35 and 40 seeds m^{-2}) and three replications. While the density of wheat was kept constant by using the seed rate of 125 kg ha^{-1} in all the plots. Wheat was sown by using manual drill on well prepared seedbed during October, 2012. Each plot consisted of seven rows of wheat, 30 cm apart (as per common practice). While *N. apiculata* were sown by mixing the required seeds with wheat seeds for each plot. To minimize the chance of low germination, higher seed rate of *N. apiculata* was used and then the required population was obtained by thinning.

Agronomic Parameters: All the agronomic parameters such as total dry matter yield and grain yield of wheat and *N. apiculata* were calculated after threshing the wheat from each plot and the data was converted into kg ha^{-1} by using the formula given below:

$$\text{Grains yield (kg ha}^{-1}\text{)} = \frac{\text{X x 10000m}^2}{\text{Row length x Row – Row distance x No. of Rows harvested}}$$

Where X = Grains yield ($plot^{-1}$)

Statistical analysis: The data regarding all the parameters were collected and then analyzed statistically by using the procedure of Jandel Scientific (1991) using Statistix, 8.1. The means were separated by using Least Significant Difference test (LSD) for knowing the significant differences among the treatment means**.**

Results and Discussion

This additive design experiment was aimed to determine the effect of different densities of *N. apiculata* on losses of the total dry matter and grain yield of wheat. Total dry matter yield of the different densities of *N. apiculata* with the constant seed rate of wheat was noted also recorded. The data regarding total dry matter yield, grains yield of wheat as affected by different densities of *N. apiculata* have been presented and discussed by using regression analyses.

Grain yield of wheat (kg ha^{-1}): The effect of various densities of *N. apiculata* on the grain and total dry matter (TDM) yield of wheat was significant (Fig. 1&2). Statistical analyses of the data regarding grain yield loss indicated that maximum losses in grain yield of wheat were at higher densities of the weed. While maximum grain yield was observed in pure stand of wheat (0 density of *N. apiculata*). Data presented in Figure 1 showed that weed density of 5 and 10 plants m^{-2} reduced wheat grains yield by 13 % and 16 %, respectively. Similarly the highest reduction in grain yield of wheat (66 %) was found in weed density of 40 *N. apiculata* m^{-2}. These results indicated that at lower densities of *N. apiculata,* its effect on grain yield was minimum but as the density of weed was increased, the losses in wheat grains yield were increased ((R^2 = 71%). Hence it is clear that the presence of *N. apiculata* in wheat can greatly decrease the grain yield of wheat. Similar findings have also been narrated by Tanweer *et al.* (1990) and Pandey and Mishra (2002). Being broadleaf and competitive weed, *N. apiculata* when crosses the level of threshold population, the losses in grain yield increase and thus crop yield is adversely affected. Due to high seed production potential of this weed, the infestation in wheat is high (Fig. 4) and thus causes significant yield losses in wheat in the area under study. In light of these studies, it is suggested that this weed be removed at initial stage to prevent the seed production and dispersal to other areas of the district.

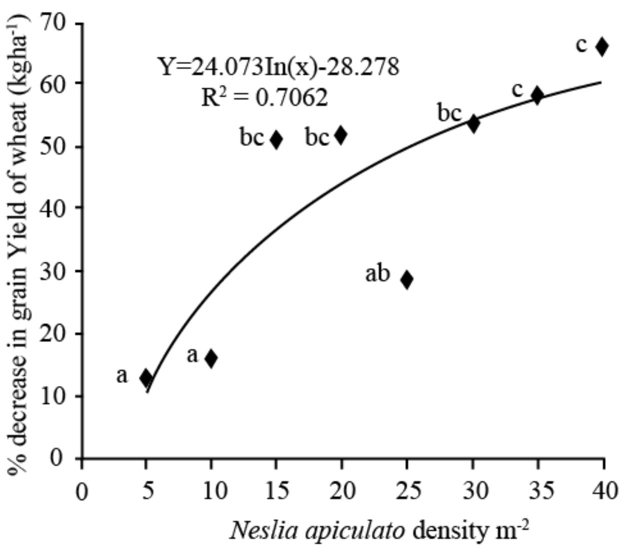

Fig. 1. % decrease in grain yield of wheat due to *Neslia apiculata*.

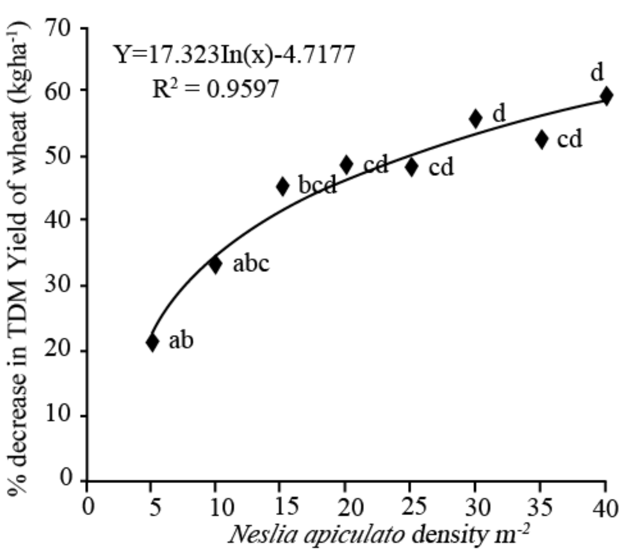

Fig. 2. % decrease in TDM yield of wheat due to *Neslia apiculata*

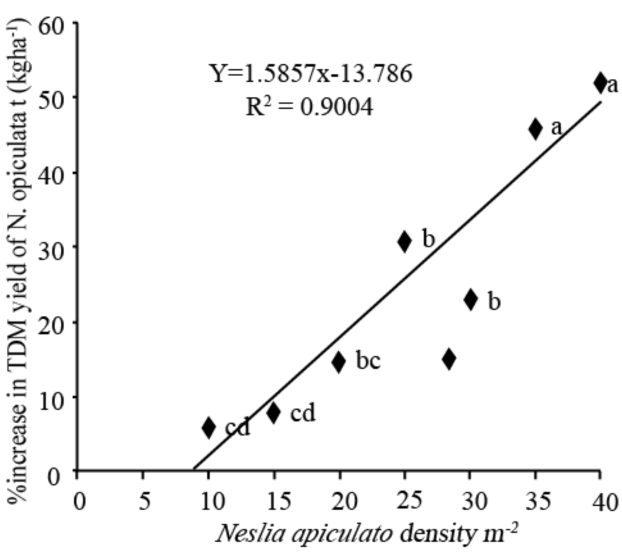

Fig. 3. % increase in TDM yield of *Neslia apiculata*

Total dry matter yield of wheat (kg ha^{-1}): The effect of different densities of *N. apiculata* on total dry matter yield (TDM) of wheat was found highly significant as shown in figure 2. The TDM yield (kg ha^{-1}) of wheat was reduced with increasing density of *N. apiculata*. It is clear from the data (not given) that the initial TDM yield of wheat at 0 weed m^{-2} was higher. But at the densities of *N. apiculata* at 5 and 10 plants m^{-2}, the reduction was observed in TDM yield and wer noted as 22 and 34 %, respectively due to *N. apiculata* competition (R^2 = 96%). While at higher density of *N. apiculata* (40 m^{-2}), reduction in TDM yield of wheat was also increased up to 60% due to severe competition between the weed and wheat plants. Different weed species growing together in a mixture and thus could be more or less competitive with each other. However, the competition between crop and weeds are usually visible on crop plants. Thus cultivar selection, seeding rates and competitive ability between various mixtures may affect the growth and development of crops in any intercropping systems (Banik *et al.*, 2006; Dhima *et al.*, 2007; Memon *et al.*, 2013; Rashid *et al.*, 2011). Weeds are undesirable plants, which infest different crops and cause negative effect on their yield (Siddiqui *et al.*, 2010). These results are also supported by the findings of Marwat and Khan (2007). They claimed that weed competition reduced grain as well as biological yield of wheat. As biological yield of wheat is also important for the farmers in the area under discussion, therefore the management of this major weed will be helpful to get higher net income.

Total dry matter yield of *Neslia apiculata*: The statistical analyses of the data regarding total dry matter (TDM) yield of *N. apiculata* revealed that the impact of different densities of *N. apiculata* is significant (Fig. 3). Maximum TDM yield of *N. apiculata* was found in the plots where the density of *N. apiculata* was highest (40 plants m^{-2}). As the plants of this weed were taller than wheat, therefore the weed taiined bigger vegetative growth and ultimately resulted in more biomass. All these results indicated that with the increase in density of *N. apiculata,* the biomass of this weed was increased (R^2 = 90%) which resulted in greater suppression of the crop and higher TDM of the weed. Moreover as the density increased *N. apiculata* competition with wheat crop was also increased, resulting in greater yield loss of wheat. These results are in line with the findings of Gaffer *et al.*, (1997) who reported that crop yield losses increased with increasing weed density. Dry biomass of *Chenopodium album* were suppressed by increasing planting density (Grundy *et al.*, (2004). While in a similar studies, it was observed that high population of weeds resulted in higher dry weed biomass (Moore *et al.*, 2004). In light of the present studies, it is suggested that presence of *N. apiculata* in wheat can drastically decrease the grain yield and biological yield of wheat. However, the decrease is weed density dependent. Due to dense population of this weed in wheat (Fig. 4) results in grain yield losses. The seed production potential of this weed is also high. Therefore, integrated efforts are needed to prevent the seed production and manage this weed in the area. Due to small size of the seeds, it can easily spread to un-infested areas.

Fig. 4. Wheat field infested with *N. apiculata* in Swat

Conclusion

It was observed that increasing density of *N. apiculata* significantly decrease the grain as well as biological yield of wheat. Such studies will facilitate the farmers and researchers in decision making processes of weed management. In light of the present studies, it is suggested that this weed may be controlled in wheat fields even if present at lower density because it will create problem in the coming years due to high seed production potential of this weed.

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