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Performance of *Azolla* on the Growth and Yield of Wheat (*Triticum aestivum*) Crop

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Abstract

An experiment was conducted to know the response of *Azolla* as a biofertilizer for wheat (*Triticum aestivum*) crop. The application of *Azolla* may be very much beneficial to conserve the environment for developing renewable, sustainable resources and to provide a natural source of nitrogen. Besides the environmental appropriateness, the use of *Azolla* may enhance the economic status of the multitudes of poor farmers by increasing yield while minimizing the cost. The present study deals with the use of *Azolla* either solitary or in combination with chemical fertilizers i.e. 60 kg N ha^{-1}. This has been noticed that *Azolla* with 60 kg N given better produce as compared to other treatments.

Key words : *Azolla*, Biofertilizer, Chemical fertilizer, Sustainable resources, *Triticum aestivum.*

Introduction

During the past few decades, there has been much advancement in science and technology leading to greater food production in the world, but the rate at which food production increased in the many developing countries has been just sufficient to meet the increased demand for food, resulting from a rapid population growth in these countries. Thus the sufficiency of global food production is still critical and is likely to be more critical in the future (Kumarasinghe and Eskew, 1993). To meet the increasing demand for food and other basic agriculture commodities, the increasing use of fertilizer and other chemical is imperative in developing country a like India. Blind excessive use of harmful inorganic fertilizers by the farming commodity e.g. Urea, pesticides and toxic insecticides to get maximum agri-produce, added fuel in fire. This resulted in waste of fertile land and put the maximum land unproduction. Now, there is a need for adaptation of biological routes of soil fertility management for preventing soil degradation and for sustaining crop production. Biofertilizer a term which refer to all such micro-organism which add, fix, and mobilize or solubilize the nutrients in simpler form which is easily use by plant. The use of *Azolla* a biofertilizer for irrigated rice cultivation has already been found successful in many countries of world (Mian, 1993). The application of nitrogen fertilizer has become an essential practice to increase crop yield. But the continuous use of only chemical fertilizers may inflict deleterious effects on soil organic matter reserve essential for health. Therefore, global attention has been drawn to find out the alternatives and supplements to chemical nitrogenous fertilizers. The addition of biofertilizers and organic manure could be a priority to address this problem.

The presence of *Azolla* mat on the surface of the water body has been shown to significantly reduce weed development, limit evapotranspiration and reduce volatilization of applied N fertilizers (N. Hamid *et al.,* 2007). *Azolla* is a free floating water fern which in symbiotic association with a blue green alga *Anabaena-Azollae* contributes substantial amount of biologically fix nitrogen to the crop. Peoples *et al.,* (1995) estimated that *Azolla* can fix 22-40 Kg N ha^{-1} month, while driving 52-99% of its nitrogen from the atmosphere. Their nitrogen fixing capability has led to it being widely used as a biofertilizer, especially in parts of South-East Asia. *Azolla* is rich in proteins, essential amino acids, vitamins & minerals. Most of the species can produces large amount of deoxyanthocyanins in response to various stresses ,including bright sunlight and extremes of temperature, causing the water surface to be covered with an intensely red carpet . (Wagner 1997; Zimmerman 1985). A study of Arctic climatology reported that *Azolla* may have had a significant role in reversing a greenhouse effect that occurred 55 million years ago that caused the region around the North Pole to turn in to a hot tropical environment. This research conducted by the Institute of Environmental Biology at Utrecht University claims that large dense patches of *Azolla* growing around freshwater lakes formed by the climate change eventually consumed enough carbon dioxide for the greenhouse effect to reverse.

The fresh *Azolla* is reported to decompose faster than dried *Azolla* and 75% of its N is released in 6-8 weeks (Singh and Singh, 1990) and release of N from *Azolla* compost is reported to be much slower. As compared with chemical fertilizers, Singh and Singh (1990) have reported that release of N from chemical fertilizer was about 87% within 10 days whereas release of *Azolla* N was comparatively slower. The observation were recorded on plant height 40, 80 and 120 DAS, plant population, plant height , length of spike and grains yield.

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Material and Method

The investigation to determine the use of *Azolla* as a biofertilizer for wheat crop was carried out at the Sultnapur, district Kannauj (U.P.) during 2008-09 and 2009-10 (November) in randomized block design (RBD) with three replication. The experimental plot $1m^2$ was prepared for sowing wheat crop variety i.e. HD 2851 obtained from IARI, New Delhi. *Azolla* was grown in tubs, was used @ 500 kg ha^{-1}. The chemical fertilizer used in two levels i.e. 120 kg N ha^{-1} and 60 kg N ha^{-1}.

T_1- Control

T_2- Farmer's practice (120 kg N ha^{-1})

T_3- *Azolla* (Solitary application)

T_4- *Azolla* + 60 kg N ha^{-1}

The requirement of seeds was 15 gm m^{-1}. Seed should be placed 5-6cm deep below the soil and the distance between rows should be 20-22.5 cm. Soil was collected from the experimental site Sultnapur, Distt. Kannauj, (U.P.).

Table-1 : Chemical Properties of the experimental soil

EC (Electrical Conductivity)	**0.68 ds/m**
pH	7.8
Available N (kg ha^{-1})	458.28
Available P (kg ha^{-1})	16
Available K (kg ha^{-1})	320
Total N%	**0.106**

Result and Discussion

Among the treated group the treatment T_4 given the best result in which *Azolla* used with 60 kg N ha^{-1} (Table- 2). Treatment T_1 given the lower yield, in which only chemical fertilizer used.

Table-2 : Performance of Azolla on the growth and yield of Wheat

T/B	Plant Population		Plant Height 40DAS(cm)		Plant Height 80DAS(cm)		Plant I 120DA
	2008-09	2009-10	2008-09	2009-10	2008-09	2009-10	2008-09
T_1	116.33	111.00	15.20	17.01	31.66	33.20	52.22
T_2	182.00	177.00	17.41	18.73	41.64	42.55	63.90
T_3	222.00	220.33	19.66	20.56	45.27	46.06	73.14
T_4	230.33	226.00	20.46	22.25	48.24	49.23	77.81

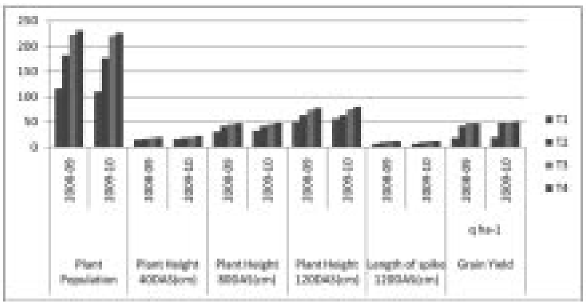

Fig. Growing Wheat at Sultnapur.

Maximum spike length was noticed in T_4 treatment and the minimum spike length was in treatment T_1 (Table-2). Treatment T_2 and T_3 have very minimum difference in their spike length. It has been reported that *Azolla* can continue nitrogen fixation even in the presence of combined N and about 75% of its N was derived from air (Kumarasinghe and Eskew, 1993).

The wheat grain yield was significantly higher for *Azolla* + Urea than farmers practice or control. The better performance of *Azolla* for increasing grain yield than for straw yield may be due to availability of more periods for *Azolla* decomposition to release its N during grain formation (Singh, 1992). Nitrogen absorbed by the wheat plant during panicle development increases filled spikelet per panicle and absorbed after flowering increases grain weight. It is also reported by De Datta (1981) in rice. While comparing the cost and yield benefit of *Azolla* with chemical – N fertilizers, its long term benefit for concomitant increase in soil fertility for sustainable agriculture should also be considered (Roger *et al,* 1993).

Azolla showed a better response for grain yield than urea, whereas chemical N-fertilizer was more useful for increasing straw yield. It is also supported by Sikander Ali (1995). The improvement in soil physical properties helps in easy tillage and thus reduces energy inputs and this loose soil also allows profuse development of crop roots (Liu 1979, Lumpkin and Plucknett 1981). The residual effect of *Azolla* alone and along with urea was superior to application of urea only. As compared to control, the increase in wheat grain yield was up to 30-40% for *Azolla* treatment. It has also been reported that *Azolla* can continue nitrogen fixation even in the presence of combined N and about 75% of its N was derived from air. (Kumarasinghe and Eskew, 1993. The results showed that *Azolla* can effectively be use as biofertilizer in wheat and saving of a large amount of chemical N fertilizer and money also. Thus the ability of *Azolla* to fix nitrogen in the presence of combined nitrogen makes its use compatible with the present day technology of using chemical N fertilizers for increasing crop production.

To see the impact of *Azolla* and fertilizer on rice yield in Model Agronomy trials at 4 locations in India, it was found that there was a 33-95% increase in yield due to *Azolla* (Singh, 1992). In India , increase in organic carbon, N, P, K and availability of micronutrient like Fe and Mn in soil as a result of *Azolla* incorporation was reported by Singh (1992).

Sikander Ali (1995) reported that wheat yield grown after rice, was higher in all the treatments than control. As compared to control the wheat straw yield was 31-32% for *Azolla* incorporated treatments and 14-15% for urea treatments. Similarly total wheat biomass was almost double for *Azolla* as compared to urea application during rice crop. The use of *Azolla* or green manure improves soil organic matter thereby soil properties like granular structure, bulk density, pore spaces, aeration, drainage and infiltration and nutrient supply increases and all these properties are essential for soil fertility, required for obtaining high crop yield and sustainable agriculture. *Azolla* has been reported to help in purification of waste water (Watanabe, 1991).

From the above results, it can be concluded that *Azolla*, used as biofertilizer increased the growth and yield of the wheat.

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