International Journal of Agriculture and Forestry 2014, 4(3A): 1-3
DOI: 10.5923/s.ijaf.201401.01

Grain Yield and Yield Components of Soybean Affected by Integrated Fertilization Methods

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Abstract Information regarded to integrated application of nano, organic and chemical fertilizers on soybean traits is not available. Therefore, the experiment was conducted as split plot based on randomized complete block design with three replications. The main plots consisted of four fertilization methods: (F1): farmyard manure, (F2): chemical fertilizers, (F3): farmyard manure + chemical fertilizers and (F4): control (without fertilizers). Sub plots were (N1): seed treated with nano-iron chelate fertilizer and (N2): control (without nano-iron). Results showed that significant variation for the effect of fertilization (F), nano-iron chelate (N) and interaction of F×N on grain yield. The pod number and seed number per pod only affected by fertilization. The 100 seeds weight does not affected by fertilization and nano iron chelate application. The highest pod number and seed number per pod was observed in co application of farmyard manure and chemical fertilizers.

Keywords Chemical fertilizer, Nano particle, Soybean, Yield

1. Introduction

Smallholder farmers in the Kurdistan province of Iran are facing problems of declining soil fertility due to intensive cultivation, nutrient removal via crop harvest and soil erosion. Use of commercial fertilizers to address the declining soil fertility remains minimal due to farmer's low income which limits their ability to purchase fertilizers. High costs of fertilizer, lack of credit, delays in delivery of fertilizer due to poor transport and marketing infrastructure, and lack of know-how about their usage have individually or jointly constrained fertilizer optimal use [8]. Several researchers have recommended Integrated Soil Fertility Management (ISFM) options for increasing soil fertility and agronomic efficiency of applied inputs [3, 7]. To increase the availability of high fertility throughout the year at reduction in its price, there is a need to use organic manure such as farmyard manure which is available in large quantity.

Legume integration into the farming systems is an important component of ISFM because of their potential to fix nitrogen and hence reduce farmers' costs for purchase of nitrogen fertilizers. Soybean (Glycine max L. Merr) has the highest worldwide area and output among oilseeds as well as edible oils. Because of its nutritional value, demand for soybean is increasing at present. Therefore, suitable production technology as well as low cost production of soybean should be encouraged to improve soybean productivity. Due to the increasing price of chemical fertilizer, low cost organic amendments are a convincing alternative for partial replacement.

Soybean is sensitive to iron deficiency, but different genotypes are various in efficiency of iron consumption. Nano-technology can present solution to increasing the value of agricultural products and environmental problems. With using of nano-particles and nano-powders, we can produce controlled or delayed releasing fertilizers. There are a few reviews about the effects of nano-particles on plants. Studies showed that the effect of nano-particles on plants can be beneficial (seedling growth and development) or non-beneficial (to prevent root growth) [9]. Thus, the objective of this study the effect of integrated fertilization system included farmyard manure, nano iron fertilizer and chemical fertilizers on the grain yield and yield components of soybean.

2. Materials and Methods

The field assay was conducted during 2013 at the research field of Islamic Azad University of Sanandaj located in Kurdistan provinces of Iran. The experiment was a split plot based on randomized complete block design with three replications. The main plots consisted of four fertilization system: (F1): 7.5 t FYM/ha, (F2): 100 kg triple super phosphate/ha + 50 kg Urea/ha, (F3): 3.75 t FYM/ha + 50 kg triple super phosphate/ha + 25 kg Urea/ha and (F4): control (without fertilizers). Sub plots were (N1): seed treated with nano-iron chelate fertilizer with 3 times of foliar applications (i.e. vegetative stage, before and after flowering) and (N2): control (without nano-iron). Main plot size was 5×25 m and

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Published online at http://journal.sapub.org/ijaf

spaces between main plots were two meter. FYM and chemical fertilizers were added to plots before sowing of soybean. Sowings were carried out in May 10.

For iron nano chelate treatments, 3g of nano chelate fertilizer was weighed and after planting seeds, this amount was mixed in a bucket full of water. Then it was poured on the seeds and into the plots after first watering of seeds. Another 1.5g of nano chelate was sprayed during the 3-4 leaf stage and the next 1.5g of it was sprayed while flowers were appearing.

The soil was irrigated to field capacity using a sprinkler system when 40% of the available soil water was depleted in the top 0.6 m of the root zone. At harvest time, the area harvested was 2 × 5 m for each sub plot. Analysis of variance (ANOVA) using the SAS – GLM procedure was used for analysis of data. Treatment means were compared using LSD test.

3. Results and Discussion

Analysis of variance showed significant variation for the effect of fertilization (F), nano-iron chelate (N) and interaction of F×N on grain yield. The pod number and seed number per pod only affected by fertilization. The 100 seeds weight does not affected by fertilization and nano iron chelate application (Table 1). The highest pod number and seed number per pod was observed in co application of farmyard manure and chemical fertilizers (Table 2).

Research has shown that application of farmyard manure significantly has an impact on the chemical, physical and biological properties of the soil. Most of these effects are due to an increase in soil organic matter resulting from manure application [2, 6]. Therefore, farmyard manure is an excellent source of major plant nutrients such as N, P and potassium (K), and also provides many of the secondary nutrients that plants require. Thus, the low yield components observed under the treatments lacking farmyard manure may be, apart from other factors, caused by the low soil K and N. Therefore, it suggests that the use of manure combined with chemical fertilizer or both enhanced good soil conditions which in turn contributed to relatively high yields.

Table 1. Analysis of variance for fertilization and nano iron effect on grain yield and yield components of soybean

S.O.V	df	pod number per plant	seed number per pod	100 seeds weight	grain yield
Fertilization (F)	3	**	**	ns	**
Block	2	**	ns	*	*
Nano-iron (N)	1	ns	ns	ns	**
F×N	3	ns	ns	ns	**

n.s., * and ** are Non- significant, significant at the 0.05 and 0.01 probability levels, respectively.

Table 2. Effect of fertilization methods on seed number per pod and pod number per plant

Treatment	seed number per pod	pod number per plant
Fertilization		
Farmyard manure	2.1 b	15.8 b
Chemical fertilizer	2.4 a	21.2 a
FYM + chemical	2.4 a	21.9 a
Control	1.7 c	9.9 c

The highest grain yield observed from F3N1 treatment (Fig. 1). It seems that the signification effect seed number per pod and pod number per plant which finally led to positive effect on grain yield. Kobraee et al. [1] reported that Iron foliar application enhanced soybean yield by influencing number of seeds per plant and seed weight. Therefore, iron deficiency in soils could be a restricting factor of yield and extremely decrease crop yield quality [4]. It seems that the use of iron nano-particles causes increasing in pod and dry leaf weight and finally will increase total yield [5].

Mean values in each priming treatment with the same letter(s) are not significantly different using LSD tests at 5% of probability.

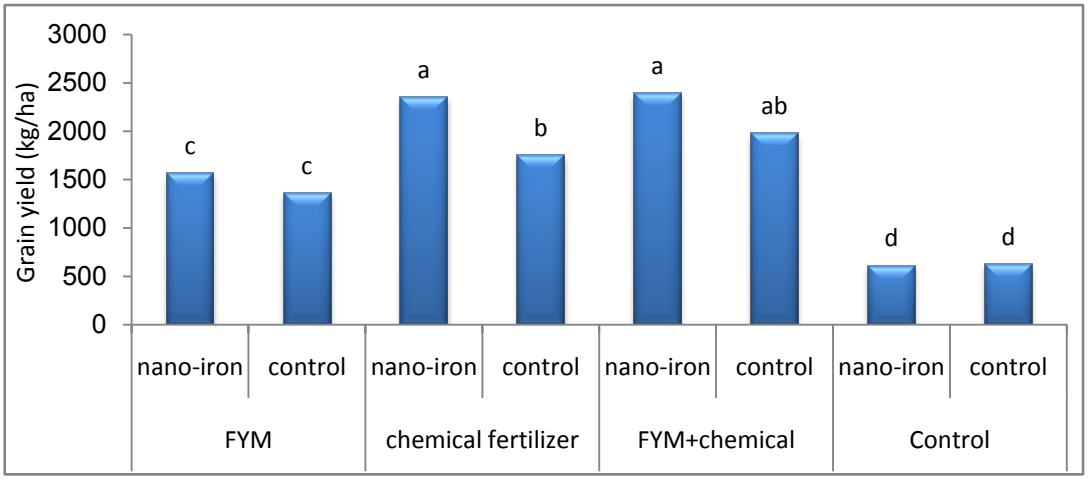

Figure 1. Interactive effect of fertilization × nano iron on soybean grain yield. (Mean values in each priming treatment with the same letter(s) are not significantly different using LSD tests at 5% of probability)

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