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Study Effects of Zinc Spraying and Nitrogen Fertilizer on Yield and Yield Components of Pinto Bean

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Abstract: In order to study effects of zinc spraying and nitrogen fertilizer on yield and yield components of pinto bean an experiment in factorial format based on randomized complete block design with 3 replications in Some Sara Township (north of Iran) was conducted. Factors of experiment consist of zinc spraying (0 and 1 g/L) and nitrogen fertilizer (0, 25, 50 and 75 kg/ha pure nitrogen). In maturity time, seed yield, 100 seed weight, number of pods per plant, number of seeds per pod and plant height was measured. Results showed that, use of zinc spraying had a significant effect in 1% probability level on all measured traits. Also, the effect of nitrogen on all studied traits was significant in 1% probability level. Interaction effect of zinc spraying and nitrogen fertilizer on number of seed per pod in 1% and on seed yield and plant height in 5% was significant and on other traits was non significant. The highest seed yield was obtained by zinc spraying application with 1990 kg/ha. Among nitrogen fertilizer levels, the highest seed yield was obtained by use of 90 kg/ha pure nitrogen.

Key words: Pinto Bean · Zinc Spraying · Nitrogen Fertilizer · Iran

INTRODUCTION

Pinto bean (*Phaseolus vulgaris* L.) is one of the most important leguminous crops in Iran for exportation and local consumption [1]. Nitrogen (N) fertilizer played a significant role in increase of crop yield [2]. Nitrogen deficiency generally results in stunted growth and chlorotic leaves caused by poor assimilate formation that leads to premature flowering and shortening of the growth cycle [3]. Limitation of nitrogen in any phase of the plant growth, causes reduction in yield [4]. Abdzad Gohari and Amiri was reported that nitrogen fertilization had a positive and significant effect on seed yield, 100 seed weight, number of pods per plant and number of seeds per plant [5]. Mohammadian roshan et al, with study effect of plant density and different amount of nitrogen fertilizer in bean culture was reported that, the highest seed yield obtained by use of 100 kg/ha nitrogen fertilizer [6]. The human body requires more than 22 mineral elements that can be supplied by an appropriate diet [7]. Fe, Zn, Ca, Mg and Mn are known to play an essential role in the metabolism and physiological process of human body [8]. Although micronutrients are required in small quantities by plants, the deficiency of any one of them can have profound effect and may cause deficiency of major elements [9]. As 70 years ago, zinc was recognized as an essential micronutrient [10] and its deficiency in agricultural crops is one of the most common micronutrient deficiencies [11]. Zinc deficient soils have been widely found in India, USA, Canada, New Zealand, Africa, Europe and South America [12]. On the other hand, World Health Organization (WHO) reported that human population of developing countries faced with the deficiencies of zinc. Zn deficiency of human is the fifth major cause of diseases and deaths in these countries [13]. Foliar fertilization has the advantage of low application rates, uniform distribution of fertilizer materials and quick responses to applied nutrients. Moreover, hidden hungers can easily be managed [14]. Mahady [15] found that foliar application of $ZnSO_4$ for faba bean plants increased number of pods/plant and seed yield. Ali and Mowafy. reported that application of foliar spray with Zn (2%) slightly improved groundnut yield and it's attributed as well as quality [16]. Thalooth *et al.* [17] indicated that foliar spraying with Zn had a positive effect on yield and yield attributes of sunflower plants. The aim of the study is to investigate the influences of foliar zinc application and different amounts of nitrogen fertilizer on yield and the yield components of pinto bean.

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Table 1: Soil analysis results of the experimental sites

Depth	0-30 cm	Soil texture	Loam clay
Clay (%)	46.58	E.C. (mmhos/cm)	1.320
Silt (%)	29.97	Total nitrogen (%)	0.194
Sand (%)	23.45	P (ppm)	9.100
pH	7.20	K (ppm)	197.000

MATERIALS AND METHODS

In order to investigation of zinc spraying and nitrogen fertilizer on yield and yield components of pinto bean (*Phaseolus vulgaris L.*) an experiment in factorial format based on randomized complete block design with 3 replications in Some Sara Township (Guilan province of Iran) with 37°12'5" N latitude and 49°38'30" E longitude in 2009 was conducted. Soil analysis results show that (Table 1), the soil texture was Loam clay and pH 7.2. Factors of experiment was included two levels of zinc spraying (z_1: without zinc spraying, z_2: zinc spraying 1g/L) and nitrogen fertilizer (n_1: control (without nitrogen fertilizer application), n_2: 25, n_3: 50 and n_4: 75 kg/ha pure nitrogen). Pure nitrogen was prepared from urea (46% pure nitrogen). For zinc spraying was used of zinc chelate (EDTA). Zinc spraying was done in two stages vegetative stage (35 days after sowing) and flowering period. Measured traits was seed yield, 100 seed weight, number of pods per plant, number of seeds per pod and plant height. The data was analyzed using MSTATC software. The Duncan's multiple range tests (DMRT) was used to compare the means at 5% of significant.

RESULTS AND DISCUSSION

Effect of Zinc Spraying: Results of variance analysis (Table 2) showed that, the effect of zinc spraying on all measured traits had significant differences in 1% probability level. In all studied traits observed that, use of zinc spraying had an optimum effect on bean characteristics. Comparison of mean showed that the highest seed yield with 1990.1 kg/ha, 100 seed weight with 43.3 g, number of pods per plant with 7.9, number of seeds per plant with 5.9 and plant height with 85.7 cm was obtained by zinc spraying (Table 3). The lowest seed yield, 100 seed weight, number of pods per plant, number of seeds per pod and plant height respectively with 1731.7 kg/ha, 42.4 g, 7.2, 4.8 and 84 cm was found from without use of zinc spraying. Similar results were reported by Khampariva [18], Agrawal *et al.* [19] and Togay *et al.* [20].

Effect of Nitrogen Fertilizer: With attention to variance analysis results, the effect of nitrogen fertilizer doses on all studied traits was significant in 1% probability level (Table 2). Comparison of mean between nitrogen fertilizer levels (Table 3) show that, the highest seed yield, 100 seed weight, number of pods per plant, number of seed per pod and plant height was obtained by 75 kg/ha pure nitrogen respectively with 2725 kg/ha, 44.60 g, 8.032, 6.11 and 88.28 cm. the n_3 level (50 kg/ha pure nitrogen) with 44.21 gram 100 seed weight placed in same statistically level with n_4 treatment (75 kg/ha pure nitrogen). In the other hand the lowest seed yield with 933.2 kg/ha, 100

Table 2: Analysis of variance related to the traits of pinto bean under different levels of zinc spraying and nitrogen fertilizer

Source of variance	df	Seed yield (kg/ha)	100 seed weight (g)	No.of pod per plant	No.of seed per pod	Plant height (cm)
				MS		
Zinc spraying (z)	1	400675.042**	4.084**	3.219**	6.966**	17.528**
Nitrogen (n)	3	3718435.042**	31.032**	1.023**	2.688**	56.144**
Z×N	3	22129.486*	0.175ns	0.163**	0.184ns	2.402*
Error	14	6462.143	0.189	0.025	0.184	0.669

Ns, ** and * respectively: non significant, significant in 1% and 5% area

Table 3: Comparison of the mean of the effects zinc spraying and nitrogen fertilizer

Treatment	Seed yield (kg/ha)	100 seed weight (g)	No. of pod per plant	No. of seed per pod	Plant height (cm)
Zinc spraying					
Z_1	1731.7b	42.4b	7.2b	4.8b	84b
Z_2	1990.1a	43.3a	7.9a	5.9a	85.7a
Nitrogen					
N_1	933.2d	39.60c	7.115d	4.538c	81.08d
N_2	1539c	42.99b	7.328c	5.167b	84c
N_3	2247b	44.21a	7.753b	5.608ab	86.03b
N_4	2725a	44.60a	8.032a	6.115a	88.28a

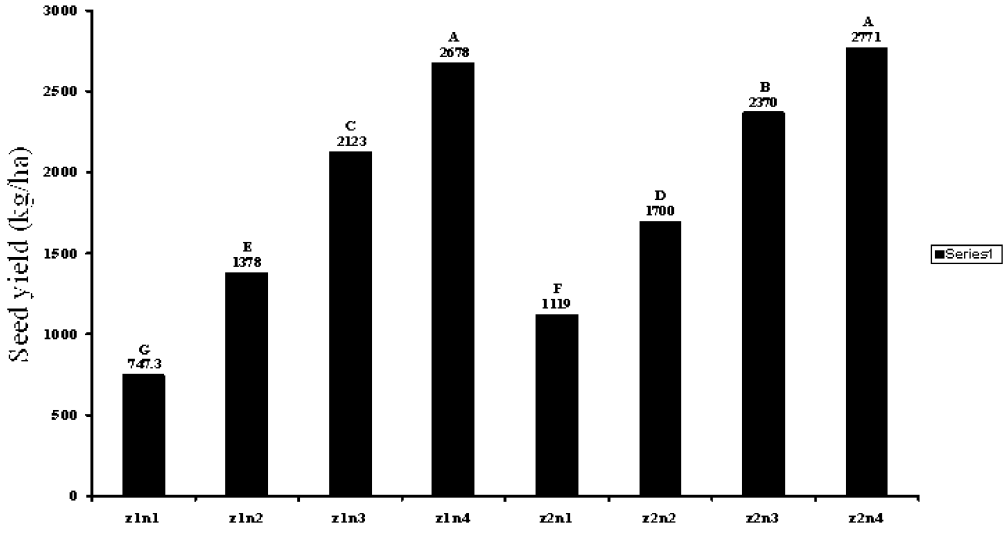

Fig. 1: Interaction effect of zinc spraying and nitrogen fertilizer levels on seed yield

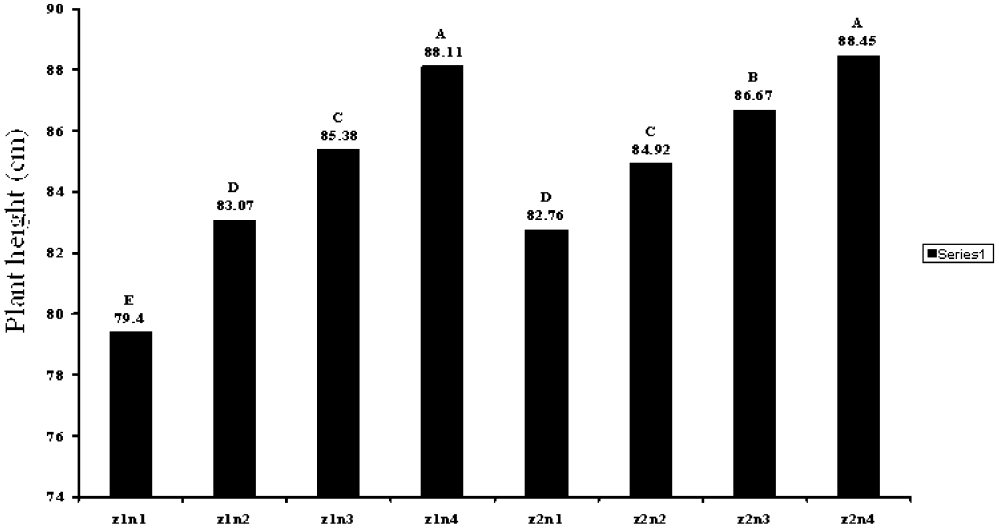

Fig. 2: Interaction effect of zinc spraying and nitrogen fertilizer levels on plant height

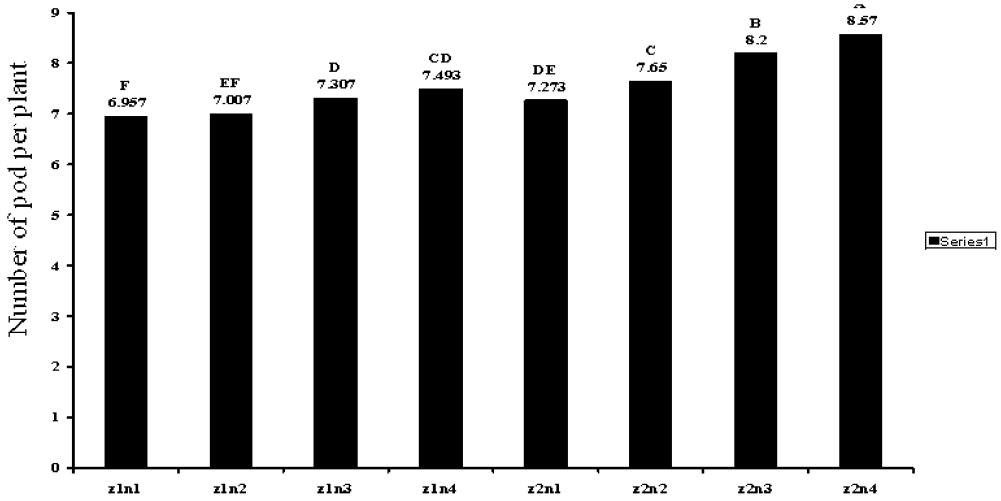

Fig. 3: Interaction effect of zinc spraying and nitrogen fertilizer levels on number of pod per plant

seed weight with 39.60 g, number of pods per plant with 7.11, number of seeds per pod with 4.53 and plant height with 81.08 cm was found from n_1 treatment (without nitrogen fertilizer application). Similar results were reported by Geetha and Varughese [21], Mirjana *et al.* [22] and Abdzad Gohari *et al.* [23].

Interaction Effect: Interaction effect of zinc spraying and nitrogen fertilizer on number of pods per plant in 1% and on seed yield and plant height in 5 % probability level was significant. But had not any significant effect on 100 seed weight and number of seeds per pod (Table 2). The highest seed yield with 2771 kg/ha, plant height with 88.45cm and number of pods per plant with 8.57 was obtained by use of zinc spraying and 75 kg/ha pure nitrogen application (Figure 1, 2, 3). On the other hand, the lowest seed yield with 747.3 kg/ha, plant height with 79.4 cm and number of pods per plant with 6.95 was found from z_1n_1 treatment (without zinc spraying and no nitrogen fertilizer application). Similar results were obtained by Koli *et al.* [24], Tsai *et al.* [25] and Abdzad Gohari *et al.* [23].

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