EVALUATION OF RATE AND SEED FILLING PERIOD OF BARLEY TO CO-INOCULATION WITH PLANT GROWTH PROMOTING BACTERIA (PGPR) AND NITROGEN FERTILIZER

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Abstract: *Present work was conducted to evaluate the inoculation effects of plant growth promoting bacteria (PGPR) and nitrogen on rate and effective seed filling period on LB-IRAN cultivar of barley. It was done in the year of 2011 growing season in growth chamber of agriculture faculty of Mohaghegh Ardabili University. It factorial experiment on the base of randomized block design. Experimented factors were nitrogen fertilizer in four levels (0, 60, 120, 180 kg per hectare) as an urea source and seed biopriming with PGPR in four levels conclude (no inoculation, inoculation with Azotobacter chroococcum strain 5, Azospirillum lipoferum strain OF and Psedomunas strain 186). Results showed that between studied treatment combinations of seed inoculation with growth promoter bacteria and different levels of nitrogen fertilizer, there are differences in effective seed filling period, maximum seed weight and the length of seed filling period. In all treatments maximum seed weight, seed filling duration and seed yield observed in inoculation with Azospirillum and highest nitrogen level and minimum one was non-inoculation and without nitrogen consumption.*

***Keywords*:** barley*, growth promoter bacteria, seed filling duration and rate*

INTRODUCTION

N2 is one of the most determinant nutrients in plant production and crop yield was determined with accessibility of it (KAFI et al, 2000). Nitrogen deficiency is as one of the limiting factors for cereals production (SHAH et al, 2003). Appling of different strain of PGPR can be so important because supplying adequate nutrient and more absorbent condition cause yield increase in crop. Although PGPR found naturally in soil but its number and density in soil is very low. So seed inoculation with these bacteria can be desirable for its population and thus cause showed its benefits in soil (CHACK MAC et al, 2007). Seed final weight as one of the determining yield component is the function of rate and seed filling period. Seed filling period is mostly used for evaluating relative seed filling period. Corporation of two factors of rate and seed filling length can determine final yield (FANI et al, 2008). The rates of photosynthetic materials that reach to seeds depend on rate and duration of seed filling period. Since the final aim is increase crop yield and there is direct relation between rate and seed filing duration and considering to proving correlation between these traits and their relationship with yield, researchers can derive a benefit of this with indirect selection. In this way an experiment was conducted for evaluating interaction of seed priming with PGPR and N2 fertilizer on rate and seed filling period of barley in greenhouse condition.

MATERIALS AND METHODS

This study was done in agronomy green house of Mohaghegh Ardabili in 2011 in factorial experiment in completely randomize design with 3 replications. Evaluated factors were nitrogen fertilizer in 4 levels (0, 60, 120 and 180 kg per hectare) and growth promoter bacteria in 4 levels (none inoculation, inoculation with *Azotobacter chroococcum* strain 5,

Azospirillum lipoferum OF and *Psedomunas* strain 186). The used seed was LB-IRAN cultivar of barley. In order to assess different levels of nitrogen fertilizer and growth promoter bacteria on the rate of barely seed filling period sampling were done 15 days after flowering step and one time per 5 days. Each time 3 cluster of pot were selected and after transferring to laboratory seeds were separated from clusters. Then put them in electric oven with conditioning in 130 ^{o}C for 2 hours. One seed dry weight was estimated with calculating seed total dry weight to seed numbers. In order to analysis and interpretation of seed filling parameters a liner regression model (two pieces) were used according to relation below.

$$GW = \begin{matrix} a + bt \mid t \langle t_0 \\ a + bt \mid t \rangle \rangle t_0 \end{matrix}$$

- GW - grain weight;
- t - time;
- b - seed filling rate;
- t_0 - final grain filling period;
- a - is.

This model separated seed weight changes to two phases. The first stage is actually the liner stage of seed filling, seed weight increase linearly to reach to its maximum levels (weight maturity). Slop of regression line in this stage ($t \langle t_0$) showed the seed filling rate (ELLIS, 1992). With fitting this model to all data, firstly two main factors, means seed filling rate (b) and time to weight maturity (t_0) were obtain and then t_0 value put in second part of relation and finally GW ,that is the seed weight, were calculated. For determining effective seed filling period below relations were used (ELLIS, 1992). EFP=MGW / GFR in this relation EFP is effective seed filling period, MGW maximum seed weight and GFR is seed filling rate.

RESULTS AND DISCUSSION

Process study of barley seed filling affected by N_2 and growth promoter bacteria were shown in fig 1-4. Evaluation of barley seed filling rate in constant levels on nitrogen shown that pattern of seed development in all PGPR s are similar. At the first seed weight increased linearly in all kind of bacteria. After that changes were not significant and became a horizontal line. According to the results it is obvious that between growths promote bacteria in constant levels of nitrogen fertilizer there are differences in some traits like effective seed filling period, maximum seed weight and seed filling duration. In treatment combination maximum weight of one seed occurred in inoculation with Azospirillum and the highest level of nitrogen fertilizer consumption and the least of them is in non-inoculation and without N2 consumption. Maximum one seed weight (38/48 mg) was in treatment combination of N_{180} × Azospirillum and minimum one (18/35 mg) was in N_0× non- inoculation. Therefore nitrogen accession, increase one seed weight and nitrogen wastage decrease it. Seems that increasing nitrogen utilization adjunct assimilates and cause boost material transportation to seed and increase seed filling of barley. KATO (1999); KUMARY and VALARMASI (1998) stated that high weight seeds have more filling rate than lowest ones. CHU et al (1987) and Tesunu et al (1994) showed that he cause of higher seed filling rate in some plant that received nitrogen fertilizer as top-dress, was higher nitrogen concentration in leaves during seed filling stage. Because nitrogen consumption during development stage, especially, seed filling period, cause elevation chlorophylls of upper leave and delay leave senescence. This led to increase the value of photosynthetic materials and photosynthesis rate in chloroplast and increase seed weight (MIURCHIAY et al, 2002).

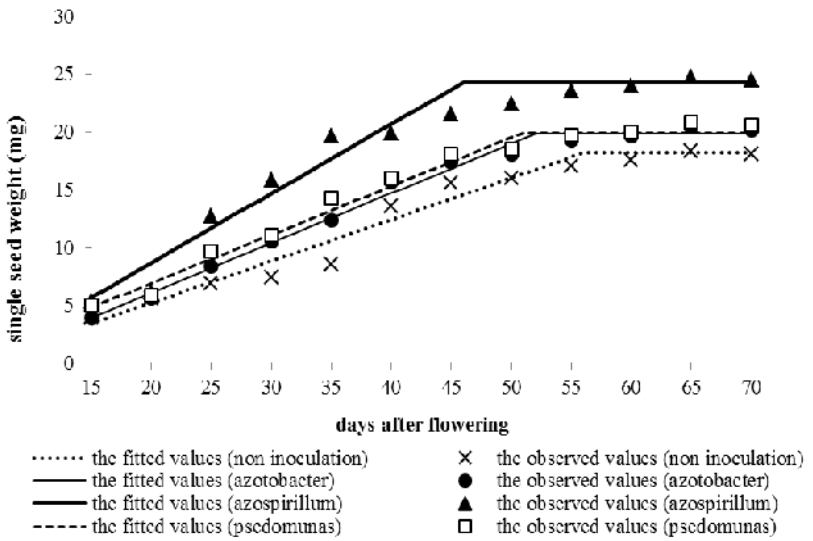

Fig. 1.The process of seed filling rate in barley in effecte of seed inoculation with PGPR and without application of nitrogen

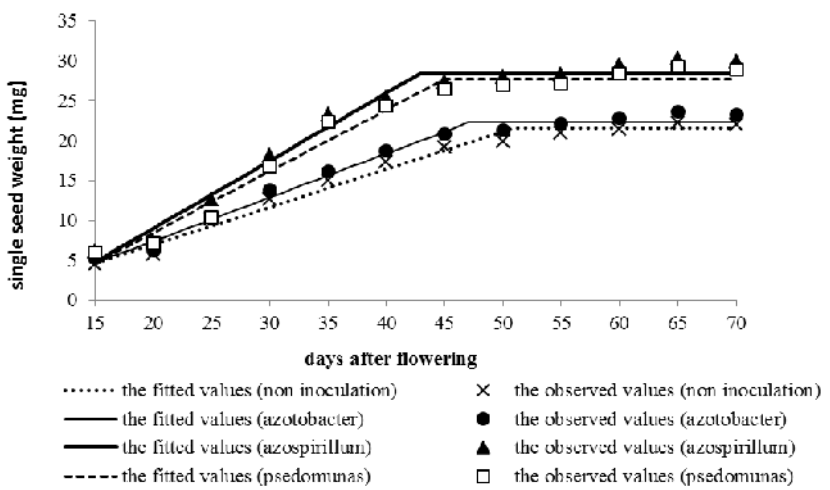

Fig. 2.The process of seed filling rate in barley in effecte of application of 60 (kg/ha) nitrogen and seed inoculation with PGPR

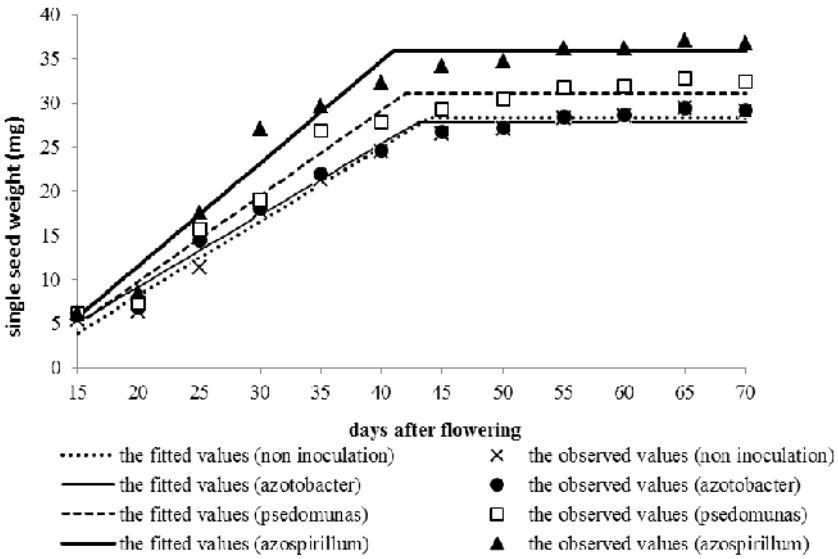

Fig. 3.The process of seed filling rate in barley in effecte of application of 120 (kg/ha) nitrogen and seed inoculation with PGPR

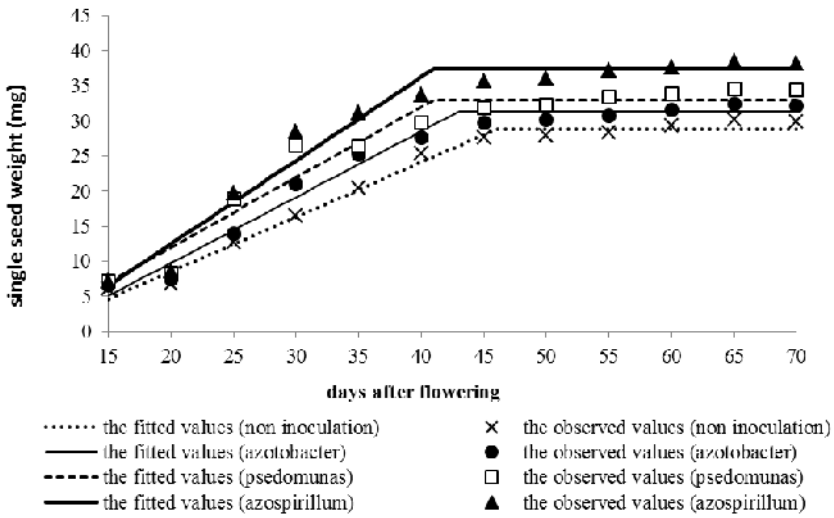

Fig. 4.The process of seed filling rate in barley in effecte of application of 180 (kg/ha) nitrogen and seed inoculation with PGPR

Results showed that seed filling period and effective seed filling period stimulate with increasing nitrogen fertilizer levels and growth promoter bacteria application. Maximum seed filling duration (55/93 days) belongs to treatment combination of N_{180} × non inoculation and the least durations (40/72 days) was in N_0×non inoculation. In conclusion, treatment combination of N_{180} × Azospirillum had the lowest slop and N_0×non inoculation with bacteria had the highest slop.

Table 1.

The effect of different levels of nitrogen and PHPR on single seed weight, effective seed filling period, seed filling duration and slope of fitted line

Been fitted to the equation	Seed filling duration (day)	Maximum single seed weight (mg)	Effective seed filling period (day)	Treatment combination
Y= -11.33+0.695x	40.72	18.35	31.96	N_0 × non inoculation with pgpr
Y= -8.05+0.700x	41.39	20.42	33.73	N_0 × azotobacter
Y= -7.08+0.833 x	43.83	24.75	36.32	N_0 × azospirillum
Y= -9.05+0.602x	42.51	20.82	34.58	N_0 × psodomunas
Y= -11.63+0.567x	41	22.23	32.33	$N_{60(kg/ha)}$ × non inoculation with pgpr
Y= -9.63+0.591x	42.13	23.62	34.55	$N_{60(kg/ha)}$ × azotobacter
Y= -7+0.638x	46.09	30.28	38.74	$N_{60(kg/ha)}$ × azospirillum
Y= -8.62+1.171x	43.46	29.23	34.96	$N_{60(kg/ha)}$ × psodomunas
Y= -8.01+0.824x	43.18	29.37	35.62	$N_{120(kg/ha)}$ × non inoculation with pgpr
Y= -6.92+0.775x	45.45	29.42	37.96	$N_{120(kg/ha)}$ × azotobacter
Y= -2.4+0.784x	50.58	37.08	47.29	$N_{120(kg/ha)}$ × azospirillum
Y= -3.6+0.762x	47.37	32.72	42.94	$N_{120(kg/ha)}$ × psodomunas
Y= -3.32+0.732x	45.84	30.22	41.25	$N_{180(kg/ha)}$ × non inoculation with pgpr
Y= -2.51+0.684x	51.27	32.48	47.48	$N_{180(kg/ha)}$ × azotobacter
Y= -1.99+0.755x	55.93	38.48	50.97	$N_{180(kg/ha)}$ × azospirillum
Y= -1.5+0.698x	51.90	34.62	49.57	$N_{180(kg/ha)}$ × psodomunas

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