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Yield, Quality and Lodging Resistance of A Few Soybean Genotypes Under Diversified Nutrient Conditions

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Abstract

Lodging of soybean (*Glycine max*) reduces yield and quality; mostly in high-yielding environments. Effect of variety, planting date, seeding rate and row spacing on lodging of soybeans were studied in past. Nitrogen promotes vegetative development, increases internode length and as a result increases lodging. Breeding for resistance to plant lodging is a priority for most soybean programs, but information is limited on effective techniques provide this. A non-nodulated and diversified nutrient containing condition is established to test if soybean lodges under these conditions. Highest grain yield of 3.52 t/ha is provided by the BDS-21 line, followed by May 5312 and Blaze varieties. Lowest yield was 2.66 t/ha. Best lodging score has achieved by the second and third best yielding varieties; these two varieties were also the shortest of trial. Future agronomic conditions will probably receive more diversified and more available nutrients to promote yields and to supply future food demands. Eliminating lodging reasoning from nutrients will improve soybean genotypes' yields and make them ready for future agronomic conditions during breeding periods. This method may be used to eliminate sensitive lines at mid-late stages of new variety development projects.

Keywords: Diversified nutrients, glycine max, lodging, soybean.

Çeşitlendirilmiş Besin Koşullarında Bazı Soya Genotiplerinin Verim, Kalite ve Yatma Direnci

Özet

Özellikle yüksek verim koşullarında soyanın (*Glycine max*) yatması verim ve kaliteyi düşürmektedir. Çeşit, ekim tarihi, ekim sıklığı ve sıra arasının yatma ve verim üzerine etkisi önceki çalışmalarda denenmiştir. Bu koşullarda azot vejetatif gelişmeyi ve boğum arası uzunluğunu artırmaktadır ki sonuç olarak yatma artmaktadır. Birçok ıslah programında, yatmaya direncin geliştirilmesi önemli önceliklerden biridir. Fakat yatmaya direncin geliştirilmesi konusunda teknik eksiklikler söz konusudur. Nodülasyonsuz ve çeşitlendirilmiş gübre koşullarında soyanın yatma düzeyini test etmek için bir deneme kurulmuştur. En yüksek tane verimi 3.52 t/ha ile BDS-21 hattından elde edilmiş, bu çeşidi May 5312 ve Blaze çeşitleri takip etmiştir. En düşük verim 2.66 t/ha olmuştur. En iyi yatma skoru en yüksek ikinci ve üçüncü verime sahip çeşitlerden elde edilmiştir; bu iki çeşit aynı zamanda denemedeki en kısa boylu çeşitler olmuştur. Gelecekte gıda talebini karşılamak için verim seviyelerini artırmamız gerekmektedir ki bu nedenle ilerideki agronomik koşullar muhtemelen daha çeşitli bitki besinleri içerecektir. Besin elementlerinden kaynaklanacak yatmanın ıslah sürecinde elimine edilmesi soya genotiplerinin verimini iyileştirebilir ve onları gelecekteki agronomik koşullara hazır kılabilir. Bu metot yeni çeşit geliştirme projelerindeki hassas hatların orta-geç dönemlerde elimine edilmesinde kullanılabilir.

Anahtar Kelimeler: Çeşitlendirilmiş gübre, glycine max, soya, yatma.

Introduction

In soybean, selection for major agronomic traits such as plant height, lodging, and maturity has been extensively applied in breeding programs for development of cultivars with high performance and adaptation [1]. Negative correlations between plant height and lodging score have been reported [2, 3]. Stem strength is one of the major influencing factors of lodging in soybean [4].

In the traditional yield trials, conducted at much lower yield levels (3-4 t/ha), lodging was not considered a major problem. Factors such as irrigation and high fertility tend to promote vegetative development and increase lodging. As soybean yields increased, lodging

became a barrier for higher yield. Some varieties are more prone to lodging which can be worse on well-drained, fertile soils.

Material and Method

Study materials are Atakisi, Arisoy, May-5312, Blaze, SA-88, Bravo, Nova varieties and BDS-21, S01-08-03 and S01-08-15 soybean (Glycine max) lines; 20-20-0 fertilizer, potassium sulphate fertilizer, Magnesium Sulphate and EDTA chelated combi micronutrient fertilizer (3% Fe, 3% Zn, 3% Mn, 0,5% Cu, 0,5% B ve 0,05% Mo).

The experiments were conducted the trial field of GAP International Agricultural Research and Training Center in Diyarbakır, under main crop conditions, with randomized complete block design with three replicate in 2014 year. Plot lengths were 5 m, width were 2.8 m and each plot contained 4 rows. Inter row spacing was 70 cm and intra row spacing was 4 cm.

100 kg/ha MAP, 50 kg/ha Magnesium Sulphate, 50 kg/ha Potassium Sulphate, 10 kg/ha EDTA chelated combi micronutrient were spreaded via tractor pulled pulverization and then field irrigated with sprinklers. Total base fertilizer application per ha in pure forms were 12 kg N, 61 kg P2O5, 25 kg K2O, 8 kg MgO, 39 kg SO3, 300 g EDTA-FE, 300 g EDTA-Zn, 300 g EDTA-Mn, 50 g EDTA-Cu, 50 g B, 5 g EDTA-Mo. Seeds were not inoculated with *Rhizobium japonicum* bacteria and nodulation was not observed during growth. Soybean seeds are drilled via sawing machine on date 24th of April 2014. Pure 150 kg/ha N top-dressed as ammonium nitrate form which was spreaded by hand.

Observations completed close to harvest and measurements on plant height, number of branches per plant, number of pods per plant, number of seeds per pods were taken. Plots are ranked according to lodging levels (1 = all plants erect, 2 = slight lodging, 3 = some lodging at a 45° angle, 4 = severe lodging, and 5 = all plants flat).

Middle two lines of each plot were harvested mechanically for the grain yields on date of 1st of October 2014. Yields, moistures and thousand grain weights were measured. Oil and protein analysis was performed via NIT analyzing equipment. The results have been evaluated on JMP statistical software package with LSD 5% method.

Results and Discussion

We didn't find significant differences in terms of grain yield at 14% moisture level. Yields ranged between 2.66 t/ha ("Nova" cv.) to 3.52 t/ha ("BDS 21" line). There were no significant differences in terms of oil contents. Oil contents ranged between 22.3% ("Arisoy"

cv.) to 23.5% (“S01-08-03” line). We didn’t find significant differences in terms of protein contents. Protein contents ranged between 36.8% (“SA-88” cv.) to 39.4% (Arisoy). We observed significant differences in terms of thousand grain weight. Thousand grain weights ranged between 122 g (SA-88 cv.) to 173 g (“BDS-21” line).

Table 1. Grain yield, oil content, protein content and 1000 grain weight values of varieties

Variety	Grain Yield (t/ha) (14% moisture)	Oil Content (%)	Protein content (%)	1000 grain weight (g)
BDS 21	3.52	23.1	38.0	173 a
May 5312	3.23	22.6	37.5	137 b
Blaze	3.09	22.4	37.6	138 b
S01-08-03	3.08	23.5	37.1	130 bc
Atakişi	3.06	22.7	37.4	134 bc
S01-08-15	3.03	23.0	37.6	132 bc
Arısoy	2.97	22.3	39.4	129 bc
SA-88	2.85	22.7	36.8	122 c
Bravo	2.80	22.6	37.8	125 bc
Nova	2.66	22.7	38.0	134 bc
Average	3.03	22.8	37.7	135
LSD (5%)	n.s.	n.s.	n.s.	14.4
C.V. (%)	14.27	2.52	3.39	6.20

We found significant differences in terms of plant height. Plant height ranged between 100 cm (“May 5312” cv.) to 130 cm (S01-08-15 line). There was significant differences in terms of number of branches per plant; lowest was 2.8 (Bravo cv.) and highest was 4 (Nova cv.). We didn’t find significant differences in terms of number of pods per plant; lowest was 57.8 (“S01-08-03” line) and highest was 79.1 (Atakisi cv.). We detected significant differences in terms of number of grains per pod. Number of grains per pod ranged between 2.7 (“Atakisi” cv. and “S01-08-15” line) to 3.1 (“May-5312” cv.).

Table 2. Plant height, number of brances per plant, number of pods per plant and number of grains per pod values of varieties

Genotype	Plant height (cm)	Number of brances per plant	Number of pods per plant	Number of grains per pod
BDS 21	115 bc	3.2 bd	65.9	2.8 bc
May 5312	100 d	3.4 ad	78.8	3.1 a
Blaze	102 d	3.6 ac	61.5	2.9 b
S01-08-03	123 a	3.4 ad	57.8	2.8 bc
Atakişi	122 ab	3.8 ab	79.1	2.7 c
S01-08-15	130 a	3.0 cd	61.1	2.7 c
Arısoy	128 a	3.3 bd	70.6	2.8 bc

SA-88	127 a	3.1 cd	69.0	2.8 bc
Bravo	111 c	2.8 d	66.9	2.8 bc
Nova	113 c	4.0 a	71.8	2.8 bc
Average	117	3.4	68.3	2.8
LSD (5%)	4.09	10.34	12.81	4.09
C.V. (%)	8.22	0.59	n.s.	0.19

Best lodging score has achieved by May 5312 cv. and Blaze cv.; lodging score was 1 for both. These two varieties achieved second and third highest yield in trial. Also these two varieties were shortest genotypes of the trial.

Table 3. Grain yield, lodging score and plant heights of varieties

Genotype	Yield (t/ha)	Lodging score (1:min-5:max)	Plant Height (cm)
BDS 21	3.52	2	115
May 5312	3.23	1	100
Blaze	3.09	1	102
S01-08-03	3.08	2	123
Atakişi	3.06	4	122
S01-08-15	3.03	2	130
Arısoy	2.97	2	128
SA 88	2.85	3	127
Bravo	2.80	2	111
Nova	2.66	2	113

As result; on the base of yield and lodging resistance, May 5312 and Blaze varieties are well performed under diversified nutrient conditions in the trial. Best lodging resistance was achieved by shortest two genotypes. Highest protein content is achieved by “Arisoy” variety (39.4 %) which has the lowest oil content (22.3 %). Best yielding genotype (“BDS-21” line) has the highest oil content (23.1) and 1.000 grain weight (173 g).

Future agronomic conditions will probably receive more diversified nutrients as average yield levels tend to be higher to supply the future demands. Also high yield environments will require more and fast available diversified nutrients. Eliminating the lodging reasoning from nutrients will improve soybean genotypes’ yields and make them ready for future agronomic conditions. This method may be used to eliminate lines at mid-late stages of new variety development stages for improved lodging resistance.

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