



Gorgan University of Agricultural
Sciences and Natural Resources

J. Plant Prod. Res. Vol. 22 (2), 2015
<http://jopp.gau.ac.ir>

Effect of arbuscular mycorrhizal fungi on some agronomic characteristics of linseed (*Linum ussitatissimum* L.) under drought stress in Shahrekord region

***M. Soltanian¹ and A. Tadayyon²**

¹M.Sc. Student, Dept., of Agronomy, Shahrekord University, Shahrekord, Iran,

²Associate Prof., Dept., of Agronomy, Shahrekord University, Shahrekord, Iran

Accepted: 21-8-2014 ; Received: 17-2-2015

Abstract

Background and objectives: One of the most important limiting factors of crop growth in the arid and semi-arid regions is water deficit stress. Mycorrhizal fungi are one of the most important microorganisms in the rhizosphere. The effects of these fungi apply via changes on some of the characteristics of roots and nutrient uptake in host plants under drought conditions. However, symbiotic mycorrhizal fungi with linseed plant have not been studied yet. Thus, this experiment was conducted in order to investigate the effect of arbuscular mycorrhizal fungi under drought stress condition on some qualitative traits and nutrient uptake of linseed.

Materials and methods: This experiment was conducted in the research station of Faculty of Agriculture in Shahrekord University. The experiment was conducted as split-plot design in RCBD with three replications. Drought stress at four levels of 100 % (no stress), 75 % (mild), 50 % (medium) and 25 % (sever stress) of water requirement, as main factor and inoculation with *Glomus intraradices*, *Glomus mosseae* and no inoculation as sub factor were treated. The measured traits were percent of seed oil, seed oil yield, proline content in leaves, and concentration and uptake of phosphorus, potassium, calcium in shoot and concentration and uptake of sulfur in seed.

Results: The results showed that the effects of drought stress treatment were significant on all measured traits except uptake of potassium and calcium. Drought stress decreased oil content (%) and oil production, concentration and uptake of phosphorus and sulfur, but increased proline content, concentration of potassium and calcium. Mycorrhiza increased all measured traits. The interaction between

*Corresponding author: msoltanian91@gmail.com

mycorrhiza and drought stress treatments was significant in all measured traits except proline content, concentration and uptake of sulfur. Regression analysis showed significant relation on the linseed traits of oil content, oil yield, P content, P absorption, K content and Ca content and these relations were linear or quadratic.

Conclusion: Based on resulted in this experiment symbiosis of linseed with of arbuscular mycorrhizal fungi under drought stress caused increase in all traits. The use of both species of fungi showed more effective than the non-application on the measurement traits. The effect of both types of fungi *Glomus intraradices* and *Glomus mosseae* was almost identical.

Keywords: Drought stress, Linseed, Nutrient, Proline, Symbiosis of mycorrhizal fungi



Gorgan University of Agricultural
Sciences and Natural Resources

J. Plant Prod. Res. Vol. 22 (2), 2015

<http://jopp.gau.ac.ir>

Effect of seed priming on germination, morphological and physiological characteristics of sesame (*Sesamum indicum* L.) under alkalinity stress

H. bekhrad¹, *B. Mahdavi² and A. Rahimi³

¹M.Sc. Student, Dept. of Agronomy, Vali-e-Asr University of Rafsanjan,

²Assistant Prof., Dept. of Agronomy, Vali-e-Asr University of Rafsanjan,

³Associate Prof., Dept. of Agronomy, Vali-e-Asr University of Rafsanjan

Accepted: 25-9-2014 ; Received: 8-2-2015

Abstract

Background and objectives: Alkalinity stress caused by the alkaline salts such as Na₂CO₃ or NaHCO₃ in the soil. Alkaline stress affected germination, growth and crop productivity. Moreover, the alkalinity stress can directly damage plant growth, alter the availability of nutrients, and disrupt the balance of ions and mineral nutrition. The application of different seed pretreatment methods is one of the ways to stimulate seed germination and growth in stress condition. One of the most common methods is the use of halopriming. Halopriming or soaking of seeds in salt solutions is one of method seed priming, which enhances germination and seedling emergence under adverse environmental conditions. So, the objective of this study was to investigate the effects halopriming on growth of sesame under alkaline stress condition.

Materials and methods: In the first experiment, factors were priming with different levels of NaCl concentrations (0, 50, 100 and 150 mM) for 6, 12, 18 and 24 hours. In the second experiment, factors were priming with different levels of NaHCO₃ concentrations (0, 10, 20 and 30 mM) for different times 6, 12, 18 and 24. The third experiment was conducted basis on result were obtained from two previous tests. In this experiment, factors were priming (non-primed (control), distilled water (hydropriming), NaCl and NaHCO₃) and alkalinity stress (0, 15, 30 and 45 mM). Alkaline stress in the pots was created by adding NaHCO₃, to half strength Hoagland's solution. Control plants were only irrigated with half strength Hoagland's solution. In this experiment, shoot and root height, potential quantum yield (Fv/Fm), performance index (PI), proline, carbohydrate, malondialdehyde

*Corresponding author: b.mahdavi@vru.ac.ir

content, potassium content, sodium content and sodium to potassium rate were measured.

Results: Results obtained from the first experiment suggested that the best treatment was 50 mM NaCl for 24 hours. The second experiment results showed that 30 mM of NaHCO₃ for 18 hours duration was the best treatment. The third experiment results showed that alkalinity stress reduced shoot length, leaf area, potential quantum yield (Fv/Fm), performance index (PI), potassium content and potassium to sodium rate, whereas increased proline, carbohydrate content and sodium content. Different treatments of priming were increased root length, shoot length, leaf area, potassium and potassium to sodium rate compared to control (non-primed). In all of alkalinity levels, priming different treatments decreased malondialdehyde content, whereas increased Fv/Fm and root length.

Conclusion: In general, results showed that alkalinity stress decreased growth of sesame and in alkalinity stress; seed halopriming decreased membrane damage (as indicated by low MDA concentration) and improved plant growth in sesame.

Keywords: Alkalinity, Germination, Halopriming, Proline, Sesame



Gorgan University of Agricultural
Sciences and Natural Resources

J. Plant Prod. Res. Vol. 22 (2), 2015
<http://jopp.gau.ac.ir>

Analysis of yield status and its relation with leaf area in wheat farms based on interpolation methods (A case study: Mazrae nemoneh Artesh, Golestan province)

***E. Mohammadi Ahmad Mahmoudi¹, B. Kamkar² and O. Abdi³**

¹M.Sc. Graduate, Dept., Agronomy, Gorgan University of Agricultural Sciences and Natural Resources, Iran, ²Associate Prof., Dept., Agronomy,

Gorgan University of Agricultural Sciences and Natural Resource, Iran,

³Superior Expert of Natural Resource Organization, Golestan province, Iran

Accepted: 31-10-2013 ; Received: 20-8-2014

Abstract

Background and objectives: In sciences like ecology, that measured value of a quantity to be processed within a definite border, the estimation of variable values in a particular time and place, by using existing data or from application of other variable information. In geoeographic studies, data collection is often the point. Usually, it is essential that this data be generalized to the total points that to be made by interpolation methods. In this study, spatial variations of leaf area index in tillering and booting stages and related values of wheat yield in Mazrae Nemoneh Artesh farm of Golestan province was evaluated using geostatistic methods and some of deterministic interpolation methods.

Materials and methods: For this purpose, 101 plant samples were taken from the farms in 2012 and aforementioned variables were recorded. Statistical indices including mean absolute error, mean bias error and root mean square error based on validation method were used as assessment indices.

Results: Analysis on semivariograms showed that the spherical, circular and exponential models were fitted better than other models on plant variables. Base on selected interpolation models, results showed that yield varied from 2.876 to 6.453 t ha⁻¹, while LAI changed from 0.304 to 2.317 and 2.66 to 6.049 m² m⁻². in tillering and booting stages, respectively. Looking at yield data and correlations between yield and leaf area index indicated that considerable difference in the amount of

*Corresponding author: esmaeil.mohammadi68@yahoo.com

produced leaf area in farms, is an important reason for the chronic variance in different parts of the farm, so that differences in leaf area estimated for A part in tillering and booting stage is 1.729 and 2.363 t ha⁻¹ and in the B part of the field is 2.013 and 3.43 t ha⁻¹, respectively.

Conclusion: Results of the correlation between yield and LAI data showed that non-coincidence machinery capacity with the farm area, resulting in significant differences in planting date of different parts, non-uniformity in soil EC and the varieties with the different potential can be most important reasons for these fluctuations.

Keywords: LAI, Kriging, Semivariogram, Yield variance



Gorgan University of Agricultural
Sciences and Natural Resources

J. Plant Prod. Res. Vol. 22 (2), 2015

<http://jopp.gau.ac.ir>

Effect of nitrogen application levels on quantitative and qualitative traits of sugar beet cultivars

***R. Deihimfard¹ and Sh. Nazari²**

¹Assistant Prof., Dept. Agroecology, Environmental Sciences Research Institute, Shahid Beheshti University, Tehran, Iran, ²Ph.D. Student, Dept. Agronomy and Plant Breeding, Bu-Ali Sina University, Hamedan, Iran

Accepted: 8-9-2014 ; Received: 5-2-2015

Abstract

Background and objectives: Over the last two decades, a large number of researches have been conducted regarding the importance of nitrogen in sugar beet. This indicate that there were needs to investigate more on nitrogen management to achive higher production and quality because less nitrogen application result in reducing yield and high nitrogen application would increase production costs and eliminate sugar beet quality. Accordingly, this research was carried out to investigate the interaction effects of nitrogen \times cultivar on some quantitative and qualitative traits of sugar beet in Khorasan province, Iran.

Materials and methods: A field experiment was carried out in research field of the Ferdowsi University of Mashhad. The experiment was a randomized complete blocks design based on factorial arrangement in three replications. Factor A was cultivar at three levels (Magnolia, Fiama and Nagano) and factor B was nitrogen applications at four levels (control, 80, 160 and 240 kg N ha⁻¹). After root harvesting, root yield per ha, above ground, suger impurity percent and pure suger percent were measured. Then, white sugar percent data, extractable sugar content, root yield, sugar yield and extraction coefficient of sugar in area was calculated using the measured qualitative traits.

Results: Results showed that nitrogen application significantly affected above-ground biomass, N concentration in root and above-ground biomass 101 days after planting and all qualitative traits except potassium concentration in root. In addition, the interaction effects of cultivar and N on harmful N content in root and all

*Corresponding author: deihim@sbu.ac.ir

quantitative traits except white sugar yield and gross sugar yield were significant. The highest root yield was observed for Fiana (120 ton ha⁻¹) under application of 240 Kg N ha⁻¹ while the highest above-ground biomass obtained 36.9 and 34.3 ton ha⁻¹ with 160 and 240 Kg N ha⁻¹, respectively. The highest gross sugar content and sugar content obtained at control treatment (lack of N application) with 17.3 and 15.7 % respectively, while the lowest observed at 240 Kg N ha⁻¹. The results also showed that N and sodium concentration in root were significantly increased in all cultivars with increasing of N application.

Conclusion: It could be concluded that nitrogen application would increase root yield while affecting the quality of sugar beet, but mobility of these elements had negative effect on sugar beet quality. The highest root yield (as a main economic value of sugar beet) obtained in Fiana cultivar with 80 Kg of nitrogen application. Extraction efficiency of sugar reduced with increasing root sodium and harmful N.

Keywords: Sugar beet, Nitrogen, Cultivar, Quantitative and Qualitative yield



Gorgan University of Agricultural
Sciences and Natural Resources

J. Plant Prod. Res. Vol. 22 (2), 2015

<http://jopp.gau.ac.ir>

Screening of rice genotypes by some morphological and physiological traits under drought stress condition

M. Nasiri¹, *M. Meskarbashi², P. Hassibi³ and H. Pirdashti³

¹Ph.D. Student of Agronomy, Ahvaz Shahid Chamran University, ²Associate Prof., Ahvaz Shahid Chamran University, ³Associate Prof., Dept. Agronomy, Genetic and Agricultural Biotechnology Institute of Tabarestan, Sari University of Agricultural Sciences and Natural Resources, Sari, Iran

Accepted: 5-12-2014 ; Received: 12-3-2015

Abstract

Background and objectives: Rice plant requires abundant water during its growth cycle and usually faced with water deficit. Drought stress alters the allocation assimilate, root and shoot growth during the vegetative period and also lower tillering, death tillers, lower plant height and flowering delay. the aim of this study was to screen different Iranian genotypes and some lines from IRRI with identify the morphology and physiology traits such as drought tolerance mechanisms in order to select drought tolerant genotypes.

Material and methods: Treatments (56 rice genotypes) were arranged in completely randomized design in two growth conditions including full irrigation and drought stress at seedling stage in Rice Research Institute of Iran, Deputy of Mazandaran (Amol) in 2013. Some morphological and physiological traits including leaf relative water content (RWC), SPAD value, leaf color (LC), plant height, leaf area and number per plant, root and shoot dry weights, root length, membrane electrolyte leakage (MEL) and pH were measured.

Results: Results showed that all traits in both well watered and stress conditions as well as genotype \times environment (G*E) interaction were significantly different. In comparison with the other characters, RWC (17.3%), root dry weight (28.2%) and shoot dry weight (21.9%) were reduced while MEL (86%) was increased in stress conditions. Correlation results showed that root and shoot dry weights were significantly correlated with plant total dry weight in stress conditions.

*Corresponding author: mmeskarshee@scu.ac.ir

Conclusion: Genotypes with better performance in stress conditions were selected as drought tolerant genotypes. These genotypes are including Tarom-Mahalli, Tarom-Deylamani, Neda, Fajr, Shafagh, Tabesh, Koohsar, Gohar, Hamr, Anboori-Ghermez, Doroudzan, Zayanderoud and Firuzan from Iranian local and improved varieties as well as seven improved lines from IRRI.

Keywords: Tolerance, Genotype, Rice seedling, Membrane leakage, Relative water content



Gorgan University of Agricultural
Sciences and Natural Resources

J. Plant Prod. Res. Vol. 22 (2), 2015
<http://jopp.gau.ac.ir>

Quantifying of germination rate response to temperature of three sunflower varieties using nonlinear regression models

***B. Kamkar¹, H. Zolfagharnejad² and N. Khalili³**

¹Associate Prof., Dept. Agronomy, Gorgan University of Agricultural Sciences and Natural Resources, Gorgan, Iran, ²M.Sc. Student of Agroecology, Gorgan University of Agricultural Sciences and Natural Resources, Gorgan, Iran, ³M.Sc. graduate Dept. Agronomy, Gorgan University of Agricultural Sciences and Natural Resources, Gorgan, Iran

Accepted: 16-3-2014 ; Received: 18-8-2014

Abstract

Background and objectives: Germination and seedling establishment are two critical and important stages during plants growing season. From seed technology viewpoint, germination refers to emergence and development from seed embryo, so that could produce normal seedling. Many studies have been done to determine germination cardinal temperatures and required thermal time for emergence occurrence, but there's not a lot of information about the sunflower cultivars. This study was aimed to investigate the germination response of three sunflower varieties (Farrokh, Hisan and Progress) and assessment of nonlinear regression models to determine cardinal temperatures and required biological days for germination of three aforementioned varieties.

Materials and methods: For this research, Farrokh, Hisan and Progress varieties seeds were exposed to five constant temperatures (15, 25, 30, 35 and 40°C) in seed research Lab., Gorgan University of Agricultural Sciences and Natural Resources in 2012. Germination duration and percentage were measured, germination rate was calculated and biological time and thermal time for germination were estimated. In order to quantify cardinal temperatures, three nonlinear regression models (segmented, dent-like and beta) were used.

Results: Results indicated that temperature and variety simple and interaction effects had significant effect on maximum germination percentage (MGP), germination rate (reciprocal time to 50% germination), and time to 10, 50 and 90% germination. Assessment of three nonlinear regression models including segmented, dent-like and beta models revealed that segmented and beta had the same quality and selected as

*Corresponding author: kamkar@gau.ac.ir

appropriate models for Farrokh, while dent-like model was selected as the superior model for Hisan and Progress varieties. For Farrokh, base, optimum and ceiling temperatures were estimated as 8.51, 33.26 (lower and upper optimum were 30.44, 37.05) and 48.47°C, respectively. The base, lower optimum, upper optimum and ceiling temperatures were estimated as (8.9, 30.41, 37.77 and 45 °C) and (9.85, 28, 38 and 47 °C) for Hisan and Progress, respectively. Biological time for 50% germination for Farrokh, Hisan and Progress also were estimated as 18.14 (20.47), 18.52 and 17.05 hour, respectively.

Conclusion: Results revealed that different sunflower varieties have different cardinal temperatures. Therefore, if we are planning to use these coefficients to quantify responses of sunflower to temperature and prediction of germination occurrence time, variety-specific coefficients should be determined and used.

Keywords: Sunflower, Cardinal temperatures, Dent-like model, Segmented model, Beta model



Gorgan University of Agricultural
Sciences and Natural Resources

J. Plant Prod. Res. Vol. 22 (2), 2015

<http://jopp.gau.ac.ir>

Effects of row and plant spacing, and minituber weight on potato yield

A.R. Bolandi¹ and *H. Hamidi²

¹Scientific member Khorasan Razavi Agricultural and Natural Resources Research and Education Center, Agricultural Research, Education and Extension Organization, Mashhad, Iran, ²M.Sc., Khorasan Razavi Agricultural and Natural Resources Research and Education Center, Agricultural Research, Education and Extension Organization, Mashhad, Iran

Accepted: 11-10-2014 ; Received: 28-12-2014

Abstract

Background and objectives: Planting density and weight of minituber are the main factors influencing the yield and yield components of potato seed tuber production. Plant density strongly affected yield, both by number and by weight, and more tubers and yield per square meter were expected in higher plant densities. Plants grown from lighter tubers spend more time for germination and their buds have thinner stems, smaller roots, and higher stem to root ratio; the number and weight of tubers produced was low in plants as well. The purpose of this study was to investigate the effects of row, plant spacing and minituber weight on Sante potato tuber yield in field conditions.

Materials and methods: This experiment was carried out in research field of Razavi Khorasan Agricultural Research Station (Torogh) as a factorial experiment in randomized complete block design with three replications, during 2012. The experimental factors were row spacing at two levels (37.5 and 75 cm), plant distances in row at two levels (15 and 20 cm) and minituber weight at three levels (<5, 5-10 and >10 gram). In this research, traits such as numbers and weight of tubers per m², diameter average, tuber weight, tuber percent with diameter <35, 35-55 and >55 millimeter, dry matter percent and total yield were measured.

Results: Results of analysis of variance indicated that there are significant variation among spacing and minituber weight for all studied traits. In this experiment, in the least plant distance (15 centimeter within-row) obtained the highest total yield. Minituber with weight more than 10 gram showed superiority in term of all traits

*Corresponding author: Hamidy1065@yahoo.com

related to yield. In this study, total yield was significantly increased with reduction of row spacing. Comparison of correlation coefficients showed that there was significant positive correlation between tuber number per m² and total yield. While, there was significant negative correlation between percentage of dry matter and total yield.

Conclusion: According to the results, the maximum number of tubers per m² and the total yield were obtained from minituber planting (greater than 10 g) with 15 cm space between plants on the row. The maximum number of tuber per plant was obtained from minituber planting with average weight (5-10 gram) at the lowest density (75*20 cm).

Keywords: Diameter of tuber, Number of tuber, Plant density, Sante, Weight of tuber



Gorgan University of Agricultural
Sciences and Natural Resources

J. Plant Prod. Res. Vol. 22 (2), 2015

<http://jopp.gau.ac.ir>

Pathogenicity variation of *Pythium ultimum* on safflower under lab, greenhouse and field conditions

***M.H. Pahlavani^{1,3}, S.E. Razavi², A. Ahmadi³ and E. Palooj³**

¹Associate Prof., Dept. Plant Breeding and Biotechnology, Gorgan University of Agricultural Sciences and Natural Resources, ²Assistant Prof., Dept. Plant Breeding and Biotechnology, Gorgan University of Agricultural Sciences and Natural Resources, ³M.Sc. student, Dept. Plant Breeding and Biotechnology, Gorgan University of Agricultural Sciences and Natural Resources

Accepted: 2-6-2013 ; Received: 5-7-2014

Abstract

Background and objectives: Seed rot caused by *Pythium ultimum* is an important disease of safflower in Iran and other countries. Therefore, finding the genetic sources of resistance and releasing of resistant cultivar is considered as important objective by safflower breeders. This disease will spread when air humidity and the moisture in the soil are sufficiently prepared and this situation occurs exactly in the time of safflower planting. So far, the damage caused by *Pythium* spp has been reported on seeds and seedlings of safflower, sorghum, wheat, alfalfa and sugar beet. In this research evaluation of seed rot for fifteen safflower genotypes for their response to causal agent was performed at laboratory, greenhouse and field conditions.

Materials and Methods: The experiments were conducted as split plot design in a completely randomized design in which sterile and infected media were included as main plot and fifteen safflower genotypes were considered as sub plot in four replicates at Gorgan University of Agricultural Sciences and Natural Resources during 2008 and 2009. Artificial inoculation in lab was conducted with 10^5 per mL zoospore suspension and in greenhouse and field infected soil with fungi agent were used.

Results: showed that there was significant difference among the genotypes for percent of seed rot in all conditions including laboratory, greenhouse and field. In

*Corresponding author: hpahlavani@yahoo.com

the sterile media, the changing trends of genotypes were similar in laboratory, greenhouse and field conditions. The highest number of non-germinated seeds was observed in a greenhouse, laboratory and field conditions, respectively. The lowest seed germination in greenhouse, laboratory and field conditions were respectively belonged to genotypes Syrian, Aceteria and LRV-5151, but the results were different at the inoculated media. Presence of genotypic variation for percent of non-germinated seeds in infected media indicated that there is a good chance for finding genotypes with low rotted seeds. Difference between two media i.e. sterile and infected to the pathogen at laboratory and greenhouse was significant, that showed the applied pathogen is the main reason for decrease in percent of germinated seeds. Three genotypes including PI-250537, Hartman and Arak-2811 had the lowest seed rot at greenhouse, laboratory and field, respectively.

Conclusion: Results showed that the lowest genotype \times medium interaction was occurred at laboratory condition that it seems quite logical because of non-variable environmental factors in these circumstances. In overall, the effects of pathogen were greater at laboratory and greenhouse than field condition. The highest percent of safflower seed rot was observed at greenhouse.

Keywords: Genotype, Germination, Seedling, Suspension, Zoospore



Gorgan University of Agricultural
Sciences and Natural Resources

J. Plant Prod. Res. Vol. 22 (2), 2015

<http://jopp.gau.ac.ir>

Effect of Zeolite application on the yield and quality of soybean under water and non-water stress

M. Agooshi¹, *M. Ghajar Sepanlou² and M.A. Bahmanyar³

¹M.Sc., Dept., Soil Science, Sari Agricultural Sciences and Natural Resources University,

²Associate Prof., Dept., Soil Science, Sari Agricultural Sciences and

Natural Resources University, ³Professor, Dept., Soil Science, Sari Agricultural Sciences and Natural Resources University

Accepted: 8-10-2014 ; Received: 5-2-2015

Abstract

Background and objectives: Every year, water stress causes great damages on crops in the world, particularly in Iran with arid and semi-arid climate so application of materials such as zeolite in soil can reduce the adverse effects of water stress. However, the effect of zeolite in increasing soil water storage capacity is different and it depends on several factors such as soil physical properties (for examples: texture and porosity) and amount, size and type of applied zeolite. This research was conducted to investigate the effect of zeolite on soybean quantitative and qualitative yield under conditions of water stress and non-water stress in two types of soil with different textures.

Materials and methods: In order to investigate the effect of zeolite on soybean quantitative and qualitative yield under water stress and non-water stress conditions in two types of soil with different textures, an experiment was conducted as split, split plot arrangements based on randomized complete blocks design with four replications and 12 treatments in 48 plots at the green house of Sari Agricultural Sciences and Natural Resources University. The main factor was different levels of irrigation (irrigation based on discharge of 25 percent of available water and irrigation based on discharge of 50 percent of available water) and sub factors included soil texture (silty clay and sandy loam) and levels of zeolite application (0, 4, 8 gram per kilogram soil). At physiological maturity stage, crops were harvested and soybean yield and yield component were measured.

*Corresponding author: sepanlu@yahoo.com

Results: The result showed that water stress caused a decrease in the number of pods, seeds, 1000 seed weight, oil percentage and seed yield, but protein percentage increased. The application of zeolite in soil caused an increase in the number of pod, number of seed, 1000 seed weight, protein percentage and seed yield but oil percentage was not affected by zeolite application. Interaction between different levels of irrigation and soil texture showed that interaction between two factors had influenced and also showed that undesirable effects of water stress on yield and component yield in sandy soil was more than those in silty clay soil. Interaction between different levels of irrigation and application of zeolite showed that with increasing 8 gram per kilogram soil in normal irrigation condition, the amount of seed yield increased about 6 percent and with increasing 8 gram per kilogram soil in water deficit condition, the amount of seed yield increased about 13 percent.

Conclusion: Application of zeolite in different levels of moisture caused a significant increase in seed yield and component yield of soybean. Using 8 grams of zeolite in one kilogram of soil, in addition to higher performance of production, in soils with light texture, can maintain soil moisture and prevent yield losses.

Keywords: Soybean, Water stress, Yield, Zeolite



Gorgan University of Agricultural
Sciences and Natural Resources

J. Plant Prod. Res. Vol. 22 (2), 2015
<http://jopp.gau.ac.ir>

Evaluation of grain yield stability of recombinant inbred lines of bread wheat (*Triticum aestivum* L.) based on AMMI method

B. Tohidi¹, Gh. Mohammadi-Nejad², B. Nakhoda³ and *Hossein Sabouri⁴

¹Former M.Sc. Student, Dept. Agronomy and Plant Breeding, Shahid Bahonar University of Kerman, Kerman, Iran, ²Associate Prof., Plant Breeding, Shahid Bahonar University of Kerman, Kerman, Iran, ³Assistant Prof., Agricultural Biotechnology Research Institute of Iran, ⁴Assistant Prof., Dept. Plant Production, College of Agriculture and Natural Resources, Gonbad Kavous University

Accepted: 20-5-2014 ; Received: 31-8-2014

Abstract

Background and objectives: However, attaining this goal is made more complicated by genotype-environment interactions. The genotype by environment interaction is a major problem in the study of quantitative traits because it complicates the interpretation of genetic experiments and makes predictions difficult, also it reduces grain yield stability in different environments. Multi-environment trials are often analyzed to assess the yield stability of genotypes. Additive main effects and multiplicative interaction (AMMI) model proved to be a powerful tool in diagnosing genotype \times environment interaction patterns. The AMMI statistical model has been widely used to explain complicate $G \times E$ interaction, to enhance selection efficiency and to ensure genetic gain from selection. The objective of this research was to investigate the response of the lines in studied locations and to identify lines adapted to the test environments.

Materials and methods: In order to investigate response of wheat lines to different environmental conditions and determination of yield stability, this study was conducted by 76 recombinant inbred lines derived the cross between Roshan \times Superhead based on randomized complete block design with two replications in five environments. The trials were performed at five locations in Kerman, Jopar, Mahan, Yazd and Ardakan. In order to evaluate the interaction and determine the stable lines, the stability analysis was done using AMMI methods.

*Corresponding author: saboriho@yahoo.com

Results: The results of the combined analysis of variance revealed significant differences of grain yield among lines, environment and also line× environment interaction ($P<0.01$). The results of Ammi2 bi-plot showed that the least distance from the center of bi-plot with minimum interaction were identified lines 3, 33, 22, 9, 271, 36, 309, 200, 114, 11, 264, 320, 194, 20, 280, 1, 26, 250, 19, 18, 25, 5, 322, 169, 152, 161 and 32 as stable lines and could be recommended for all location. Lines 258, 218, 176, 48, 82 and 314 for Yazd and line 225 for Ardakan indicated the best response and they had private adaptation to these places.

Conclusion: Overall, based on the results of this experiment, among evaluated lines, lines number 9, 3 and 22 were introduced as general stable lines based on AMMI1, AMMI2 and AMMI stability value (ASV) parameter. Therefore, the identified promising lines can be recommended to complementary studies for introduce to farmers.

Keywords: Bi-plot, Stability, AMMI Analysis, Wheat, Recombinant inbred lines



Gorgan University of Agricultural
Sciences and Natural Resources

J. Plant Prod. Res. Vol. 22 (2), 2015
<http://jopp.gau.ac.ir>

Effect of foliar application time of salicylic acid on some of the morphology properties and pigments of tomato (*Lycopersicon esculentum*) fruit

M. Hafeznia¹, K. Mashayekhi² and F. Ghaderifar³

¹M.Sc student, Dept. Horticulture, Gorgan University of Agricultural Sciences and Natural Resources, ²Associate Prof. Dept. Horticulture, Gorgan University of Agricultural Sciences and Natural Resources, ³Associate Prof. Dept. Agronomy, Gorgan University of Agricultural Sciences and Natural Resources

Accepted: 5-4-2014 ; Received: 7-1-2015

Abstract

Background and Objectives: Tomato plays an important role in providing vitamins and minerals in human nutrition, it has a great potential in exports. As well as it is an important vegetable due to its variety of vitamins, carotene, useful acids, sugar and minerals play an important role in human health. Regarding the fact that tomato is one of the most significant products and its consumption is rising up day after day, performing the extensive investigations is highly important in order to increase the production per unit and enhancing the quality of the fruits characteristics such as, stiffness, high preservation and increasing the pigment which affect the improvement the color and the pomace.

Materials and method: In order to test salicylic acid on tomatoes (Supra cultivar) in Deland area in Golestan province an experiment was carried out based on complete randomized block design through the four replications and four treatments. A solution containing salicylic acid with 10^{-4} M concentration was sprayed at different times (from cultivating to harvesting the products, from cultivating to the flowering, from flowering period up to the fruiting. and water solution as a control) with 15 days interval. Measuring factors in this experiment included morphological characteristics such as the number of the first cluster of leaves, plant height and number of flowers, yield components characteristics including fruit number and biochemical traits like chlorophyll a, b, total chlorophyll, carotenoids, leaves anthocyanin, fruit anthocyanin, pH and titratable acidity, Determining the amount of

*Corresponding author: maryhafeznia@yahoo.com

anthocyanin of leaf was according to the method of Vangr (1979). Arnon method (1995) was used for the measurement of chlorophyll a, b and total chlorophyll and carotenoids in tomato leaves.

Results: Application of salicylic acid from seedlings transplanting to harvest significantly increased leaf area of the plant. Application of salicylic acid from seedling transplanting until harvest time to the first cluster to increase the number of leaves, number of flowers per cluster and the number of fruit per cluster, as well as significantly reduced plant height of tomato.

Conclusion: According to the survey results, utilizing of typically 10^{-4} M salicylic acid, as the foliar application from beginning up to the end of cultivation, causes higher total chlorophyll pigments in the plant and the overall rate of photosynthesis.

Keywords: Tomato, Salicylic acid, Plant height, Chlorophyll, Anthocyanins



Gorgan University of Agricultural
Sciences and Natural Resources

J. Plant Prod. Res. Vol. 22 (2), 2015

<http://jopp.gau.ac.ir>

Sequencing and phylogenic study of *aox2* gene in Anthemideae subfamily

*A. Yamchi

Assistant Prof., Dept. Plant Breeding and Biotechnology, Gorgan University of Agricultural Science and Natural Resources, Gorgan, Iran

Accepted: 8-11-2013 ; Received: 17-8-2014

Abstract

Background and objectives: Medicinal plants, today it is one of the most important agricultural products. Progress in the field of medicinal plants is one of the most important goals at the moment is the agricultural sector. Although medicinal plants in our country has been very little attention, but the increasing importance of these plants around the world, today, has attracted the attention of many parts of agriculture. The Anthemideae is considered as an important subfamily of Asteraceae which contains 5 important medicinal genera including *Achillea sp.*, *Matricaria sp.*, *Tanacetum sp.*, *Artemisia sp.* and *Santolina sp.* Since genera belong to Anthemideae subfamily are rich in antioxidant components which be protected against ROS effects. Antioxidants including two groups named as enzymatic and non-enzymatic. Plant antioxidants have fewer side effects compared to synthetic ones. Alternative oxidase is one of the important enzymes in electron flow gradient to control alternative respiration and *aox2* gene codes one of subunits of that enzyme. So, detecting and sequencing encoding genes of antioxidants seem essential.

Materials and methods: At the first, according to multiple alignments, the sequences of Arabidopsis as a model plant and other plants were elicited from gene bank information database. Specific degenerative primers were designed based on conserved amino acid sequences of *aox2* protein. Primers amplified a 300 bp fragments in all studied genera and subsequently were sequenced.

Results: To investigate the *aox2* genes diversity among important genera of Anthemideae, average pairwise distance using K₂P and P-distance model and genetic diversity based on transition and transversion were calculated. Results showed the mentioned genera were well conserved for *aox2* gene. *Matricaria sp.* and *Achillea sp.* have more similarity and also *Artemisia sp.* and *Chrysanthemum sp.* have more distance to each other.

Conclusion: Obtained data from cluster diagram verified a more conserved volume between mentioned genera for *aox2* gene.

Keywords: Anthemideae, Antioxidant, Aox2 gene

*Corresponding author; yamchi@gau.ac.ir



Gorgan University of Agricultural
Sciences and Natural Resources
J. Plant Prod. Res. Vol. 22 (2), 2015
<http://jopp.gau.ac.ir>

Evaluation of tuber yield and growth indices of potato genotypes in mountain and plain conditions in Golestan province

***R. Sarparast¹ and A. Melikyan²**

¹Scientific member of Mazandaran Agriculture and Natural Resources Research Center, ²Professor Armenian National Agrarian University

Accepted: 20-7-2013 ; Received: 8-12-2014

Abstract

Background and objective: Potato (*Solanum tuberosum* L.) cultivation in two different climates causes difference in its growth process. In these conditions, The most frequently used indicators of growth for plants are the tuber growth rate (TGR), crop growth rate (CGR) and leaf area index (LAI). Shoot dry weight is the easiest, quickest and least costly component to measure the competitive features of plants. The results of some studies showed that LAI is an appropriate criterion for estimating the degree of crop yield variation. This study has been carried out to investigate the physiological parameters affecting the performance of fourteen potato genotypes based on the growth indices in different stages of the plant growth period from germination to maturity, as well as the tuber yield in two different weather conditions, i.e. Shahkooh mountain (for spring planting) and Gorgan plain (for autumn planting).

Material and methods: This experiment was carried out in the randomized complete block design with three replications and nine breeding population (genotypes) called 396151-29, 397009-7, 397007-9, 397007-11, 397097-14, 397009-3, 397009-8, 396151-7, 396140-14 together with the varieties of Agria, Sante, Satina, Burrena and Marella, with a total of 14 treatments with six 4-meter lines, with 75 cm row spacing and 25 cm plant spacing on lines in ridge and furrow pattern.

Results: The results showed that the highest crop growth rate was obtained by 397097-14 (13 g/m²/day) and 397009-7 (20.1 g/m²/day) at autumn and spring planting, respectively. The highest leaf area index was 3.60 for genotypes 397009-3

*Corresponding author: ram_sarparast@yahoo.com

and 3.36 for 396140-14 at spring and autumn planting, respectively. At the end of the growth period when the leaf area index was decreasing, the difference among genotype at spring sowing increased. Genotypes 397009-7 and 397009-3 produced the highest yields (27056 and 28446 kg/ha) at autumn and spring planting, respectively. Genotype 397009-7 was considered the best genotype for producing 11.9 and 12.5 tuber per plants at autumn and spring sowing, respectively.

Conclusion: In this 3-year experiment the average yield in spring planting (Shahkooh) was higher than autumn planting (Gorgan). It was also shown that the genotypes had different thermal needs, which could have been due to changes in air temperature in different years and places, which has ultimately led to changes in the plant growth rate and crop yield. The results of the present study indicated that genotype 397009-3 having higher leaf area index and crop growth rate could produce higher dry matter and store more and as a consequent, they justified its higher economical yield.

Keywords: Crop growth rate, Dry matter, Genotypes, Tuber yield



Gorgan University of Agricultural
Sciences and Natural Resources

J. Plant Prod. Res. Vol. 22 (2), 2015

<http://jopp.gau.ac.ir>

Genetic analysis of resistant to *Septoria Tritici* Blotch using Diallel crosses

***Sh. Vakili Bastam¹, S.S. Ramezanpour² and H. Soltanloo²**

¹Ph.D. Student, Nuclear Agriculture, Dept., of Plant Breeding and Biotechnology,
Gorgan University of Agricultural Sciences and Natural Resources, Gorgan, Iran,

²Associate Prof., Dept., of Plant Breeding and Biotechnology, Gorgan University of
Agricultural Sciences and Natural Resources, Gorgan, Iran

Accepted: 4-1-2014 ; Received: 10-9-2014

Abstract

Background and objectives: *Septoria tritici* blotch (STB), caused by *Mycosphaerella graminicola* (anamorph *S. tritici*) is currently the most serious disease of wheat worldwide. This study was established to determine the function of resistant genes of *M. graminicola* to find out the number of genes corresponding in resistant reaction and also to estimate the genetic parameters of resistance.

Materials and methods: Eight winter wheat genotypes were selected based on preliminary field and greenhouse observations of their reaction to *S. tritici*. Twenty-eight F₁ wheat genotypes derived from an eight-parent half diallel set of crosses and their parents were planted in a randomized complete blocks design (RCBD) with three replications. Plants were inoculated in tillering, long stem and appearance of flag leaf stages. Disease rating was visually recorded by using the double-digit scale (00–99). Data analysis by Hyman and Jinks method was performed using D2 genetic software. Disease severity and its AUDPC (sAUDPC) were calculated.

Results: For the validity of additive-dominance model, two scaling tests were employed following Mather and Jinks. For both traits, the regression coefficient test, indicated that b differed significantly from zero but not from unity and according to second test, t² was not significant, Thus, both tests suggested adequacy of the additive-dominance model for these characters. Following Mather and Jinks for both traits, the regression coefficient test indicated that b differed significantly from zero but not from unity and also t² value was not significant that validate additive-dominance model. The ratio of dominance effect of heterozygous loci to corrected dominance variance for both traits was less than 1 suggesting the control of one gene

*Corresponding author: shahrbanouvakili@yahoo.com

group. High narrow and broad sense heritabilities were recorded for both traits (over 80% and 95% respectively). Greater portion of heritable variation was of additive nature. Line 10 carries additive resistant genes, so selection would be effective. Dominant alleles in disease severity and SAUDPC led to decreasing level of traits and increasing resistance to *Septoria Tritici* Blotch. Since the selection of resistant generations of crosses between parents based on their cross direction is predictable, by crossing parents with high resistance can improve wheat genotypes *Septoria Tritici* Blotch resistance. Based on the results doing cross between line#10 and N-81-18 to produce suitable cultivar with permanent resistance to *Septoria Tritici* Blotch is recommended.

Conclusion: Results showed that additive effects are responsible for much of the variance of heritability. Genotype line#10 had most of the resistance genes to *Septoria Tritici* Blotch compared to other genotypes which suggested as donor parent for resistance genes in breeding programs.

Keywords: *Septoria Tritici* Blotch, Genetic of resistance, Resistant gene effect, Heritability