EJCP., Vol. 12(3)
http://ejcp.gau.ac.ir
DOI: 10.22069/ejcp.2019.14761.2108

Effect of water superabsorbent levels, nutrition management and salicylic acid on soil characteristics, water use efficiency and morphological characteristics and yield of red bean (*Phaseolous vulgaris* L.) in drought stress

M. Jahan[1*] and M.B. Amiri[2]

[1]Associate Professor, Department of Agrotechnology, Faculty of Agriculture, Fedrowsi University of Mashhad, Mashhad, Iran

[2]Assistant Professor, Department of Plant Production, University of Gonabad, Gonbad, Iran

Received: 16-2-2018 Accepted: 02-11-2019

Abstract

Background and objectives: Today, more than a one third of the worlds land is located in arid and semi-arid areas that are subject to water constrains. Drought stress causes different physiological changes in the plant, such as increasing shading temperature, increasing concentration of proline amino acid, decreasing leaf relative humidity, increasing soluble sugars concentration, increasing stomatal resistance and increasing concentration of antioxidant compounds of plant. Considering the destructive effects of drought stress, in recent years, many efforts have been made to increase water use efficiency. The use of superabsorbents and spraying of humic acid and salicylic acid are considered as essential solutions for saving and optimizing water use. Regarding insufficient water availability in the country and the importance of using ecofriendly inputs in increasing water productivity and conducting few studies on the use of statistical techniques to identify the factors affecting water use efficiency, this research was conducted in order to investigate the effect of water superabsorbent, humic acid and salicylic acid on water use efficiency and some morphological characteristics and yield and tolerance indicators of bean (*Phaseolous vulgaris* L.) under drought stress.

Materials and methods: In order to determine factors affecting water use efficiencies of common bean (Derakhshan cultivar) affected by different inputs in conditions of drought stress, a split plot experiment based on RCBD design with three replications was used during 2015-16 growing season, at Research Farm of Ferdowsi University of Mashhad, Iran. Irrigation levels (50 and 100% of water requirement) and nutritional treatments (75 Kg ha^{-1} Nitrogen+80 Kg ha^{-1} Superabsorbent, 80 Kg ha^{-1} Superabsorbent + 6 Kg ha^{-1} Humic acid + 1 Mm Salicylic acid, 6 Kg ha^{-1} Humic acid + 1 Mm Salicylic acid + 75 Kg ha^{-1} Nitrogen, 6 Kg ha^{-1} Humic acid + 1 Mm Salicylic acid + 75 Kg ha^{-1} Nitrogen+80 Kg ha^{-1} Superabsorbent and Control) assigned to the main and sub plots, respectively. In this research, traits such as seed yield, dry matter yield, harvest index, weight seed per plant, plant height, LAI, CGR, soil nitrogen, phosphorous, EC and pH was measured.

Results: The result showed that all of the nutritional treatments had significantly effects on water use efficiency, but in both conditions of 50 and 100% of water requirement, the highest water use efficiency were obtained in Humic acid + Salicylic acid + Nitrogen + Superabsorbent, so that this treatment increased water use efficiency 63 and 55% compared to control in 50 and 100% of water requirement, respectively. All of the nutritional treatments decreased damages caused by drought stress, but in this conditions (50% of water requirement), the highest LAI (7.24), CGR (6.47 g.m-2.day-1), soil nitrogen (0.32%) and phosphorous (0.0183%) observed in treatment of nitrogen + superabsorbent + humic acid + salicylic acid. Application of nitrogen+ superabsorbent, superabsorbent + humic acid + salicylic acid, nitrogen + humic acid + salicylic acid and nitrogen + superabsorbent + humic acid + salicylic acid increased mean productivity

*Corresponding author; Jahan@ferdowsi.um.ac.ir

(MP) 19, 54 and 47 and 59%, geometric mean productivity (GMP) 18, 55 and 48 and 59% and harmonic mean (HM) 17, 55 and 48 and 60% compared to control, respectively. Effect of nutritional treatments on stress susceptibility (SSI) and stress tolerance index (STI) was significant and the lowest SSI (0.59) and the highest STI (1.51) obtained in treatment of nitrogen + superabsorbent + humic acid + salicylic acid.

Conclusion: In general, the results showed that although all nutritional treatments were effective in reducing drought stress damages, but the highest seed yield, dry matter yield, harvest index, weight seed per plant, leaf area index, crop growth rate, soil nitrogen and water use efficiency observed in treatment of nitrogen + superabsorbent + humic acid + salicylic acid. MP, GMP and HM in all nutritional treatments was more than control, significantly. Application of superabsorbent + humic acid and salicylic acid, nitrogen + humic acid + salicylic acid, nitrogen + superabsorbent + humic acid + salicylic acid decrease SSI compared to control and the highest STI obtained in treatment of nitrogen + superabsorbent + humic acid + salicylic acid.

***Keywords*:** Harmonic mean, Humic acid, Net nitrogen, Soil pH, Susceptibility index

EJCP., Vol. 12(3)
http://ejcp.gau.ac.ir
DOI: 10.22069/ejcp.2020.17020.2267

Pattern of antioxidant enzyme activities under drought stress and exogenous application of proline in sunflower

A. Bandehagh[1*], M. Valizadeh[1], M. Ghaffari[2], F. Jahangir[1] and Z. Dehganian[1]
[1]Department of Plant Breeding and Biotechnology, Faculty of Agriculture, University of Tabriz, Tabriz, Iran.
[2]Oil Crops Research Department, Seed and Plant Improvement Institute, Agricultural Research Education and Extension Organization (AREEO), Karaj, Iran.

Received: Accepted:

Abstract

Background and objectives: Drought stress disturbs metabolic pathways in plant cells that leads to increase in reactive oxygen species (ROS) abundance. Plants have high efficient defensive system that prevents oxidative stress and can eliminate free radicals. Therefore high activity of antioxidant enzymes is essential for drought stress tolerance. Knowledge of antioxidant enzymes function and variation can be suitable marker to identification of morphological characteristics linked to this enzyme activities in plant breeding programs under drought conditions.

Materials and methods: In order to study the effect of drought stress and endogenous treatment of proline on the anti-oxidant enzymes superoxide dismutase (SOD), catalase (CAT), and peroxidase (POX), drought treatments (0, -4, -8 bar created by adding polyethylene glycol-6000) and 3 levels of proline (0,5, 10 mM) were applied on sunflower in seedling stage. This research was conducted in a factorial experiment based on completely randomized design, including 10 sunflower genotypes (in two susceptible and tolerant groups).

Results: Based on the changes in proline content and shoot dry weight, two inbred lines BGK 329 and RGK 221 were identified as the most susceptible and most sensitive among 10 inbred lines. Then, stripe pattern of enzymes was studied in 7.5 percent horizontal acrylamide gel electrophoresis. Quantitate evaluation of activity of observed isozymes and statistical analysis of the data indicated that there is a significant difference among the activity of four enzymes SOD_1, SOD_2, CAT_1, and POX_1, out of all 7 enzymes. No significant change was observed in activity of isozyme SOD1 with increasing water stress and proline levels. Interactions of genotype× proline was significant ($p<0.05$) for POX_1 and SOD_2. Drought stress had significant effect on isozyme CAT_1 and interaction of stress× genotype affected the activity of isozyme SOD_2. While the activity of isozyme POX1 was significant at stress× proline interaction, the triple effect of triple stress× proline× genotype was significant ($p<0.01$) in the activity of isozyme POX_1. SOD_2 activity was largely influenced by the genotype so that at different levels of stress and proline, some genotypes increased and some others showed decreased activity. The exogenous 5mM proline treatment reduced the activity of isozyme POX1 and CAT1 under stress. Data analysis based on two susceptible and tolerant sunflower groups under drought stress showed that only POX1 activity was significant between the two groups and therefore.

Conclusion: Proline as an important amino acid induces drought stress tolerance. An efficient antioxidant defensive system with inducible expression system to increase the accumulation of proline have a vital role in the tolerance of drought stress environments. Isozyme of POX could be suggested to identify drought tolerant drought genotypes in seedling growth stage.

Keywords: Densitometric analysis, Electrophoresis, Isozyme, Peroxidase, Superoxide dismutase .

*Corresponding Author: Bandehhagh@tabrizu.ac.ir

EJCP., Vol. 12(3)
http://ejcp.gau.ac.ir
DOI: 10.22069/ejcp.2019.15436.2150

Modeling of irrigated wheat yield potential and gap in Iran

M. Zahed[1*], A. Soltani[2], E. Zeinali[3], B. Torabi[4], E. Zand[4] and S.M. Alimagham[1]

[1]PhD student, Department of Agronomy, Gorgon University Agricultural Sciences and Natural Resources, Gorgan, Iran
[2]Professor, Department of Agronomy, Gorgon University Agricultural Sciences and Natural Resources, Gorgan, Iran
[3]Associate Professor, Department of Agronomy, Gorgon University Agricultural Sciences and Natural Resources, Gorgan, Iran
[4]Assistant Professor, Department of Agronomy, Gorgon University Agricultural Sciences and Natural Resources, Gorgan, Iran
[4]Professor, Department of Weed Research, Plant Protection Research Institute Tehran

Received: 30-7-2018 Accepted: 27-11-2019

Abstract

Background and objectives: Wheat provides around 40 percent of edible energy and protein for people in Iran. Closing yield gap can increase wheat production, significantly. The first step of closing yield gap is to quantify the yield gap at a given region or country. The amount of wheat yield gap hasn't been measured for whole Iran by a global standard protocol so far. The aim of this study is to estimate irrigated wheat yield gap for Iran based on the global yield gap analysis (GYGA) protocol.

Materials and methods: GYGA protocol suggested a method to calculate yield gap on a large scale like a country. Based on this protocol, at first the area covered by each weather stations were specified. Second, the main weather stations where cover irrigated wheat lands were selected named reference weather stations (RWS). Then, irrigated wheat yield potential was estimated by SSM-iCrop2-wheat simulation crop model within the RWSs. The actual irrigated wheat yield was calculated for each RWS based on GYGA protocol as well. Forth, amount of the actual and potential yield was calculated for whole country by using the values calculated for the RWS according to GYGA protocol. Finally, the yield gap was calculated by difference between potential and actual yield for the country.

Results: The results of this study showed that average irrigated wheat in Iran was 3.4 ton/ha, average potential yield was 8.8 ton/ha and average yield gap was 5.4 ton/ha (62%). At the moment, irrigated wheat producers just use 38 present of the existing wheat cultivars and environment potential. There was no significant relationship between climate in the irrigated wheat production RWS and irrigated wheat yield gap (based on percent) in Iran and the yield gap was around 62 percent in all the RWSs. If farmers could reach 80% of potential yield of their locations, by improving agronomy practices, average irrigated wheat would reach 7 tons/ha and there is around 2.2 million ha irrigated wheat area in Iran. Thus, average wheat production in irrigated condition would increase from 7.5 million tons to 19.8 million tons.

Conclusion: Owing to existing wheat cultivars and climates in the main irrigated wheat production RWS in Iran, there is a big yield gap of wheat in Iran. The low actual irrigated wheat yield in Iran (3.4 tone/ha) can be attributed to the poor management condition because the existing cultivars and climates have no limitation to reach the yield around 8.8 tone/ha. There are many factors to reduce the yield such as poor seedbed preparation, irrigation amount and timing etc.

Keywords: GYGA protocol, Potential yield, SSM model, Wheat

[*]Corresponding author; mahboube.zahed@gmail.com

EJCP., Vol. 12(3)
http://ejcp.gau.ac.ir
DOI: 10.22069/ejcp.2019.15494.2157

Effect of crop density and sowing date on the growth indices and weed control of chickpea (*Cicer arietinum* L.)

B.A. Rashidzadeh[1], E. Elahifard[2*], A.R. Siahpoosh[3] and M. Farkhari[4]

[1]Graduate student in Weed Science, Department of Plant Production and Genetics, Faculty of Agriculture, Agricultural Sciences and Natural Resources University of Khuzestan

[2, 3 and 4]Assistant Professor, Plant Production and Genetics Department, Faculty of Agriculture, Agricultural Sciences and Natural Resources University of Khuzestan

Received: 11-8-2018 Accepted: 25-9-2019

Abstract

Background and objectives: One of the important requirements in agronomic planning is to determine the best and most suitable sowing date in order to achieve high quality and desirable quality of yield. Therefore, this experiment was conducted in order to determine the most suitable planting date and plant density in terms of weed control in dryland chickpea in Koohdasht, Lorestan, Iran.

Materials and Methods: The experiment was conducted as split plot in randomized complete block design with four replications with three planting dates (20 January, 8 February and 28 February) as main plot and four densities (16, 32, 48 and 64 plant m^{-2}) as sub plot in 2016-2017 in the climate conditions of Koohdasht. Sampling from chickpea and weeds was done four weeks after planting until the end of the growing season with a time interval of 7-10 days. In order to describe the changes in total dry matter (w_{max}) and maximum leaf area index (LAI_{max}) against time after planting (t), the truncated expolinear and beta model was used, respectively.

Results: The results showed that the dry matter changes and leaf area index during the growing season are consistent with the truncated expolinear and Beta models. So that the parameter w_{max} at the first, second and third sowing dates at 16-64 plants m^{-2} in weed free conditions, ranged from 154.90-371.70, 119.60-310.80 and 60.87-187.90 g Dry matter m^{-2} and in weed infested condition ranged from 98.69-266.60, 56.78-186.90 and 35.53-114.00 g dry matter m^{-2}. Regarding the LAI_{max} parameter, at the first, second and third sowing dates at 16-64 plants m^{-2} in weed free conditions, ranged from 0.49-9.32, 0.46-7.97, 0.39-4.50 g and in infested conditions 0.39-6.25, 0.69-5.18 and 0.21-2.79 g was estimated. Weed dry weight increased in weed infected plots over time. So that weeds dry weight on 28 February were more than other sowing dates. Also, the highest percentage of yield loss occurred in the second planting date at a density of 16 plants per square meter. In general, the first sowing date with density of 48 plants m^{-2} with a yield of 1703.327 kg ha^{-1} of chickpea was the best treatment compared to the same sowing density at the second sowing date (1534.7 kg ha^{-1}) and the third sowing date (470.55 kg ha^{-1}).

Conclusion: In the present study, the maximum dry matter and the maximum leaf area index of chickpea plants were decreased in weed infested conditions compared to weed free conditions in all three sowing dates. So that the reduced values in the less sowing densities were more than the higher sowing densities. In the other words, by increasing the planting density in the presence of weeds, the farmer will be able to avoid a significant reduction in the yield loss due to competition with weeds. By comparing the sowing dates of chickpea in terms of maximum dry matter, leaf area index and yield loss percentage of chickpea plants, it can be stated that the conditions for chickpea growth and development in the first sowing date were better than the other sowing date.

***Keywords*:** Dry matter changes, leaf area index, yield loss.

[*]Corresponding author: e.elahifard@asnrukh.ac.ir

EJCP., Vol. 12(3)
http://ejcp.gau.ac.ir
DOI: 10.22069/ejcp.2019.15743.2171

Assessment of Soybean yield changes using meteorological and satellite-based drought indices in the west of Golestan province

P. Alizadeh[1*], B. Kamkar[2], Sh. Shataee[3] and H. Kazemi Poshtmasari[4]

[1]Ph.D student of Agronomy, Gorgan University of Agricultural Sciences and Natural Resources, Gorgan, Iran
[2]Professor, Department of Agronomy, Gorgan University of Agricultural Sciences and Natural Resources, and Department of Agrotechnology, Ferdowsi University of Mashhad, Iran
[3]Professor, Department of Forestry, Gorgan University of Agricultural Sciences and Natural Resources, Gorgan, Iran
[4]Associate Professor, Department of Agronomy, Gorgan University of Agricultural Sciences and Natural Resources, Gorgan, Iran

Received: 15-10-2018 Accepted: 13-7-2019

Abstract

Background and objectives: In the most parts of the country, the number of meteorological stations is inadequate and don't cover the appropriate statistical period. The conventional method of yield assessment in Iran is based on those experiments which require numerous field measurements, that makes it expensive, difficult and sometimes impossible. On the other hand; the final data is available much later than when field managers need them. Remote sensing data can be used as an alternative or complementary data for meteorological data to estimate the yield, drought and crop vegetation. To evaluate the soybean yield and its relationship with drought risk potential in western parts of Golestan province (AQ-Qala, Aliabad Katoul, Gorgan, Bandar-e-Gaz, Bandar-e-Torkaman and Kordkouy), the meteorological (SPI) and Landsat satellite imagery-based vegetation indices (including NDVI, VCI and DSI) were used.

Materials and Methods: In this study Landsat satellite images from 2000 to 2016 were used. After appropriate pre-processing and processing, the vegetation indices were prepared. Also the meteorological drought index (SPI) was calculated using the weather stations data of the study area. To calculate the relationship between the soybean yield and all aforementioned studied indices (NDVI, DSI, VCI and SPI indices), the averaged-DN average for each index in each city was calculated. Then, the yield of each city was regressed against the meteorological (SPI) and satellite-imagery based indicators (NDVI, DSI and VCI). The linear function with the highest significant determination coefficient was selected and the soybean yield map was provided for the study area. The final drought risk model was adopted using drought frequency maps for SPI, DSI and VCI indices. The yield change in all drought risk categories was assessed through investigating the compatibility of the Boolean-classified yield maps and drought risk maps of the studied region.

Results: Coefficient of determination for yield prediction in different years ranged from 0.13 to 0.52, also the most of the predicted values were put in confidence level of 15% range of discrepancy which proved the accuracy of used equations in predicting yield maps. It can be concluded that yield can be predicted in a precise and accurate manner at the peak of soybean vegetation growth by applying meteorological and satellite-imagery indicators. The results showed that the yield of 43% to 50% of the soybean fields was higher than reported mean yield. Results showed that soybean fields in the AQ-Qala, Aliabad Katoul, Gorgan, Bandar-e-Gaz, Bandar-e-Torkaman and Kordkouy counties were not classified as very severe drought risk

*Corresponding author; parysa.alizadeh@gmail.com

areas. The compliance of the yield and drought risk maps indicated that the possibility of yield reduction in facing with drought is higher in those areas with higher drought risk.

Conclusion: Totally, the results showed that Bandar-e-Torkaman, Gorgan and the central and southern parts of Aliabad Katoul are facing a lower risk of drought. The intersected map of yield and drought risk can be used as a predictive tool to provide strategies to manage drought risks as well as coping with drought effects on the yield.

***Keywords*:** Agricultural Drought, Drought Risk, Remote Sensing, Yield

EJCP., Vol. 12(3)
http://ejcp.gau.ac.ir
DOI: 10.22069/ejcp.2019.16031.2192

Effects of salicylic acid on agro-physiological traits of black cumin (*Nigella sativa* L.) grown under different humidity regimes

H. Azadvari[1], M. Naeemi[2*], A. Gholizadeh[2] and A. Nakhzari Moghadam[2]

[1]M.Sc in Agro-ecology, Department of Plant Production, Faculty of Agricultural and Natural Resources, Gonbad Kavous University,

[2]Assistant Professor, Department of Plant Production, Faculty of Agricultural and Natural Resources, Gonbad Kavous University

Received: 13-12-2018 Accepted: 25-9-2019

Abstract

Background and objectives: Drought stress is one of the major factors limiting plants growth. Salicylic acid (SA) is a natural phenolic compound playing an important regulatory role in plant different processes. Studies have indicated that external application of SA increased plant tolerance to several abiotic stresses, including osmotic stress, drought, salinity, ozone or UV radiation. The purpose of this study was to evaluate the interactive effects of different humidity regimes and application methods of SA on some physiological and biochemical parameters, grain yield and determination of the most suitable application method of salicylic acid in black cumin.

Materials and methods: This study was conducted based on randomized complete design with factorial arrangement of treatment and three replications at Gonbad Kavous university research field in 2018 growing season. Different irrigation regimes at four levels including no irrigation (rainfed), once irrigation at flowering stage, once irrigation at grain filling stage and double irrigation at flowering and grain filling stages and salicylic acid factor at three levels including non- application (control), seed priming (with 0.5 mM concentration), foliar spraying (with 0.5 mM concentration) were studied. After applying of treatments, some traits including total chlorophyll content, antioxidant enzymes activity (catalase, peroxidase and ascorbate peroxidase), leaf relative water content, leaf water saturated deficiency, 1000 grain weight, grain yield, biological yield and harvest index were evaluated.

Results: The results showed that interaction effects of irrigation and salicylic acid on all evaluated traits were significant except for biological yield. Salicylic acid foliar spraying increased activity of peroxidase and ascorbate peroxidase antioxidant enzymes in all irrigation treatments while not significantly affecting catalase enzyme activity. Means comparison revealed that the highest total chlorophyll content (26.2 mg/g FW), RWC (72.44%) and seed yield (1329 kg/ha) obtained from SA foliar spraying application and double irrigation treatment.

Conclusion: Results indicated that SA application especially foliar spraying activated antioxidant system and also improved plant moisture condition and chlorophyll content which finally resulted in enhanced growth and desirable yield under different humidity treatments. Therefore, application of SA can be introduced as an effective approach for regulation and decrease of stress effects and desirable yield production in areas subjected to water deficit.

***Keywords*:** Antioxidant, Black cumin, Grain yield, Salicylic acid, Water deficit

[*]Corresponding author; naeemi_701@yahoo.com

EJCP., Vol. 12(3)
http://ejcp.gau.ac.ir
DOI: 10.22069/ejcp.2019.16177.2205

The effect of irrigation intervals on growth, physiological and biochemical indices of coneflower (*Echinaceae purpurea* (L.) Monch) under humic acid foliar application

H. Gorgini Shabankareh[1*], S. Khorasaninejad[2], M. Sadeghi[3] and P. Ebrahimi[4]

[1]PhD student in Medicinal Plants at Horticultural Sciences Dept. Gorgan University of Agricultural Sciences and Natural Resources,

[2]Assistant Prof. Horticultural Sciences Dept. Gorgan University of Agricultural Sciences and Natural Resources, Gorgan, Iran

[3]Senior Expert and Assistant of Plant Productions of Golestan Jahad keshavarzi,

[4]Associat Professor, Golestan University

Received: 16-1-2019 Accepted: 13-7-2019

Abstract

Background and objectives: Drought is one of the most important factors limiting the growth of plants around the world and the most common environmental stress. Considering the serious risk of drought and water scarcity, the use of appropriate methods to improve the negative effects of drought has attracted special interest. Recently, different types of organic acids have been widely used to improve the quality and quantity of crops and horticultural products. Due to the hormonal compounds, extremely low amounts of organic acids have significant effects on the improvement of physical, chemical and biological properties of the soil and the production and quality of agricultural products. In this regard, an experiment was conducted to investigate the effect of irrigation intervals and the foliar application of humic acid on some morphophysiological and biochemical characteristics of coneflower.

Materials and Methods: This experiment was conducted in the 2016-17 crop year with split plot arrangement in a randomized complete block design with three replications at the research farm of the Baharan non-profit organization in Gorgan. The treatments were included four levels of irrigation intervals (including the irrigation every one, three, six and nine days) and four levels of humic acid foliar application (including 450, 300, 150 and 0 mg/L). The measured traits included plant height, root length, fresh and dry weight of plant, fresh and dry weight of root, proline, relative water content (RWC) of leaves, antioxidant activity, total phenol and soluble sugar.

Results: The results showed that the increased levels of irrigation intervals caused a significant decrease in plant height, root length, fresh weight of plant, and fresh and dry weight of root, while the highest dry weight of the plant (9.41 g per plant) and root length (10.40 cm) was observed from the second and third levels of irrigation interval, respectively. Also, the effect of irrigation interval at the highest level resulted in 29.88% reduction in the relative water content of leaf and 69.29% increase in proline compared with the control. The level of antioxidant activity and soluble sugar was increased with the irrigation intervals, and at the third level of irrigation (irrigation every six days), it was at most 71.39 and 43.56 mg/mL, respectively. Humic acid treatment had a significant effect on all of the measured traits except carotenoid, and the effect reached to the maximum level at 450 mg/L. In the conditions of irrigation every nine days, the foliar application with 450 mg/L resulted in a 0.58% increase in proline compared with not to use it in this condition. The maximum level of antioxidant activity (82.67 mg/mL)

*Corresponding author; h.shabankareh92@gmail.com

from the third level of irrigation interval and application of 150 mg/L of humic acid and the highest level of soluble sugar (53.56 mg/g) from the third level of irrigation interval and application 300 mg/L of humic acid was observed.

Conclusion: The results of this study showed that increasing the irrigation interval significantly reduced the morphological traits. In contrast, some traits such as proline, antioxidant activity, total phenol, and soluble sugar were increased. However, humic acid protects the coneflower plants from the drought stress and reduces the drought damage. In general, the results of this study introduced the foliar application of 300 mg L^{-1} of humic and every 9 days irrigation as the best treatment, economically. Because with less water and acidic consumption, the same level of metabolite performance as higher levels of these applications can be achieved.

Keywords: Antioxidant activity, Dehydration stress, Organic fertilizer, Proline, Total phenol.

EJCP., Vol. 12(3)
http://ejcp.gau.ac.ir
DOI: 10.22069/ejcp.2019.16385.2219

Effect of plant density on phenological stages, morphological traits, yield and yield components of different cultivars of rapeseed

F. alizadeh[1], F. Zaefarian[2*], B. Torabi[3] and R. Abbasi[4]

[1]MSc student of Agronomy, Sari Agricultural Sciences and Natural Resources University, Sari, Iran
[2]Associate Professor of Agronomy, Sari Agricultural Sciences and Natural Resources University, Sari, Iran
[3]Associate Professor of Agronomy, Gorgan Agricultural Sciences and Natural Resources University, Gorgan, Iran
[4]Assistant Professor of Agronomy, Sari Agricultural Sciences and Natural Resources University, Sari, Iran

Received: 5-3-2019 Accepted: 15-6-2019

Abstract

Background and objectives: Rapeseed is superior to other oilseed crops in the country due to its positive traits such as resistant to cold weather and drought stress, salt tolerance and higher yield per unit area. Factors affecting the yield of plants are the use of suitable cultivars adapted to the climatic conditions of each area in appropriate planting density, in such a way that there is at least a destructive competition between the plants. Regarding the fact that each plant, or, in a better way, each cultivar indicates a specific reaction to environmental factors, and also due to the high capacity of rapeseed for improving the yield as a result of environmental factors, this study aimed to determine the most suitable plant density and variety for improving yield and yield components of rapeseed as an important oil seed crop.

Materials and Methods: This experiment was conducted as factorial based on a randomized complete blocks design in a research farm of Gharakhil Agricultural Research Center in Ghaemshahr in 2017-2018. The treatments consisted of five densities of 42.1, 66.66, 88.88, 114.28 and 133.33 plants.m^{-2}, respectively. Second factor for this experiment was included four canola cultivars: Hayola 401, Agamex, Hayola 4815 and Teraper, which were performed in three replications. The traits studied in this experiment included: SPAD index, flowering duration stage, no. of days to the end of flowering, plant height, number of branches per plant, number of pods per plant, seed number per pod, 1000 seeds weight, seed yield, biological yield and harvest index.

Results: Results showed that the maximum biological yield and seed yield (16150 and 7031.8 kg.ha^{-1}) were related to Hyola 401 cultivar with 88.88 plants.m^{-2}. The main effect of density and variety on harvest index, 1000 seed weight, number of pods per plant, number of seeds per pod and number of branches were significant. The density of 88.88 plants.m^{-2} was the highest in pod number per plant (21.58), 1000- seed weight (4.24 g) and harvest index (59.19 percent). The results also showed that the highest pods per plant was related to 66.66 plants.m^{-2} and maximum number of branches was with density 42.10 plants.m^{-2}. In all traitselated to yield and yield component, the Hyola 401 cultivar showed better performance than other cultivars.

Conclusion: Results showed that there is a significant difference between plant densities and different cultivars of rapeseed for yield and yield components. Hyola 401 cultivar with 88.88 plant m^{-2} had the best result in terms of yield and yield components. Therefore, according to the results, Hyola 401 cultivar and 88.88 plants.m^{-2} are recommended for achieving high yield in rapeseed in Mazandaran weather conditions.

Keywords: Density, Harvest index, Hyola 401, SPAD index.

*Corresponding author; fa_zaefarian@yahoo.com

EJCP., Vol. 12(3)
http://ejcp.gau.ac.ir
DOI: 10.22069/ejcp.2019.16511.2229

Quantifying symbiosis effect of *Piriformospora indica* and *Trichoderma longibrachiatum* fungi on some vegetative and physiological traits of canola under lead stress

M. Emamian Tabarestani[1], H. Pirdashti[2*], M.A. Tajik Ghanbary[3] and F. Sadeghzadeh[4]

[1]Ph.D. student of Agronomy, Sari Agricultural Sciences and Natural Resources University, Sari, Iran
[2]Associate Professor, Department of Agronomy, Genetics and Agricultural Biotechnology Institute of Tabarestan, Sari Agricultural Sciences and Natural Resources University, Sari, Iran
[3]Associate Professor, Department of Plant Protection, Sari Agricultural Sciences and Natural Resources University, Sari, Iran
[4]Assistant Professor, Department of Soil Science, Sari Agricultural Sciences and Natural Resources University, Sari, Iran

Received: 14-4-2019 Accepted: 25-9-2019

Abstract

Background and objectives: Agricultural soils in many parts of the world are slightly to moderately are contaminated by heavy metals elements. Among them, Pb has an effect on growth and metabolism of plants with a wide range of adverse effects like decrease in root elongation and biomass, accelerated leaf senescence, inhibition of chlorophyll biosynthesis and seed germination, interferes with nutrient uptake, influence the net photosynthetic rate and respiration and alternate permeability of cell membrane. So, the usage of a fast and safe method is necessary to remove pollutants with the lowest cost and impact on the environment. One of the best methods is phytoremediation that the Brassicaceae family plants such as canola (*Brassica napus* L.) have a special ability to refine contaminated soils due to their much biomass production. On the other hand, bioremediation is one of the methods that has been considered in recent years to remove contaminants. In this context, it is important to use a variety of microorganisms like algae, fungi and bacteria in order to improve phytoremediation efficiency. Therefore, the purpose of this research was to evaluate the effect of *Piriformospora indica* and *Trichoderma longibrachiatum* on improving the growth and some physiological traits of canola under lead stress.

Materials and Methods: This research was done as factorial layout based on a completely randomized design with three replications. Treatments were four levels of lead from lead nitrate source (0. 500, 1000 and 1500 mg kg^{-1} of soil) and three treatments of fungi (control, *Piriformospora indica* and *Trichoderma longibrachiatum*). After 60 days of (Hyola 401 cultivar) planting time, coinciding with the end of vegetative growth and before flowering, Vegetative and some physiological traits were measured. To quantify the effect of lead stress regression analysis and linear and segmental models were used.

Results: The results showed that node and leaf number, stem diameter, leaf fresh weight and stem dry weight (between 20 and 58%) were reduced as linearly and segmental model where lead levels increased from zero to 1500 mg. Also, inoculation of *Piriformospora* and *Trichoderma* fungi increased stem diameter and dry weight. Using the mentioned fungi had a positive effect on vegetative traits at different levels of lead. Accordingly, plant height, leaf area, stem and shoot fresh weight and leaf and shoot dry weight reduced from 27, 74, 68, 65, 69

*Corresponding author; h.pirdashti@sanru.ac.ir

and 70% in control to 12, 44, 35, 36, 52 and 52% in symbiosis with *Piriformospora* and 31, 48, 58, 53, 52 and 53% after applying *Trichoderma* at in 1500 mg as compared to the zero levels, as well. Also, the electrolyte leakage rate showed an increasing trend with 0.000084 slope Up to 500 mg and then with a 0.0018 slope. But plant inoculation with *Piriformospora* and *Trichoderma* reduced the electrolyte leakage with about two percent. In addition, the interaction between lead and fungi was significant on SPAD reading, chlorophyll *a*+*b*, relative water content (RWC) of leaves and proline. SPAD reading and chlorophyll *a*+*b* declined from nearly 18 and 35% in non-inoculation treatment to about 7 and 27% in *Piriformospora*, and 13 and 5% in *Trichoderma* in 1500 mg as compared to the control, respectively. Among morphological and physiological traits, the highest correlation (r=0.80; *P*<0.01) was between leaf area and RWC.

Conclusion: In conclusion, results indicated that vegetative traits showed more sensitivity to lead toxicity. Among these traits, the highest sensitivity was recorded in stem and shoot dry weights. Inoculation of canola seed with *Piriformospora* and *Trichoderma* fungi ameliorated this sensitivity in some traits. Accordingly, it seems that these fungi can improve slightly the adverse effect of lead toxicity and increase canola tolerance to lead stress.

***Keywords*:** Proline, *Trichoderma*, Lead, Mycorrhiza-like, Canola

EJCP., Vol. 12(3)
http://ejcp.gau.ac.ir
DOI: 10.22069/ejcp.2019.16574.2236

Effect of organic, chemical, and integrated nutrition resources and zeolite application on some qualitative and quantitative traits of two soybean cultivars

H. Amiri[1], A. Ghalavand[2*] and A. Mokhtassi-Bidgoli[3]
[1]Ph.D. student, Department of Agronomy, Islamic Azad University, Khorramabad, Iran
[2]Proffesor, Department of Agronomy, Islamic Azad University, Khorramabad, Iran
[3]Associate Professor, Department of Agronomy, Tarbiat Modarres University, Tehran, Iran

Received: 2019-3-16 ; Accepted: 2020-2-8

Abstrac

Background and objectives: Nowadays, conventional farming has resulted in many negative foot prints such as groundwater Pollution, soil erosion, and decreasing food quality, therefor using alternative management methods, such as organic and integrated farming are necessary for crops sustainable production. Application of organic fertilizers (manure) and zeolite could improve crop yield by supplying nutrients and modifying soil physical, chemical, and biological properties. Due to the importance of soybean (*Glycine max* L.), this research was aimed to evaluate the effect of organic, chemical and integrated nutrient resources along with zeolte apllication on yield and quality traits of two soybean cultivares.

Material and methods: To investigate the effect of chemical and biological fertilizers and application of zeolite on seme quantitive and quality traits of two soybean cultivars, a factorial experiment based on the randomized complete block design with three replications was conducted at a field which is located at Aleshtar in 2014 and 2015. The factors were consisted of two soybean cultivars (M7 and M9) and five fertilizer systems (100% organic fertilizer, 100% chemical fertilizer, 50% organic plus 50% chemical fertilizer, 25% organic plus 75% chemical fertilizer, 75% organic plus 25% chemical fertilizer) and four zeolite rates (0, 4, 8 and 12 tons ha^{-1}). The rate for 100% manure was 22.6 and 26.7 ton ha^{-1} and for 100% chemical fertilizer was 241 and 247 kg N ha^{-1} in the first and second season, respectively.

Results: The highest seed yield of M7 cultivar in the first year (2896 kg ha^{-1}) and the second year (2971) was obtanid under integrated fertilizer systems of 75 organic manure+25%chemical fertilizer along with high zeolite rate (12 ton ha-1) and the lowest seed yield was achieved at chemical fertilizer without apllication of zeolite. 75% organic fertilizer + 25% urea with 12 ton zeolite $ha^{-1}$and 50%, urea + 50% organic fertilizer with 6 ton zeolite ha^{-1} combinations led to the highest seed oil yield for M7 and M9 cultivars, respectively, while the lowest values in M7 and M9 cultivars were achieved at 100% urea fertilizer and 50%, urea + 50% organic fertilizer treatments without zeolite application (Z1), respectively. The increasing zeolite rate improved both qualitative and quantitative traits in two cultivars, as, increasing the zeolite from 0 to 12 ton ha-1 rose M7 seed yield by 55, 73 and 66% in F2, 100% urea, F4, 75% urea + 25% cattle manure and 75% cattle manure + 25% urea treatments, respectively. Also, adding zeolite amendment improved both oil and protein yield of cultivars.

Conclusion: Since the integrated nutrition manegment of 75% organic manure+25% chemichal resulted in reduced chemical fertilizers as well as increased yield and quality of two cultivars, this tratments could be considered as asuitable nutrient manegment method for soybean

*Corresponding author: ghalavaa@modares.ac.ir

production in this area. Also, due to higher yield and better qulitve properties of M7 cultivar than M9 cultivar, it would ne considered as a proper cultivar in this area.

Keywords: Chemical fertilizer, Combination nutrition, Dry matter, Organic fertilizer, Soybean.

EJCP., Vol. 12(3)
http://ejcp.gau.ac.ir
DOI: 10.22069/ejcp.2019.16549.2237

The effect of vitamins B group and melatonin foliar application on soybean growth indices, leaf senescence and yield components

Y. Mohammadi[1], M. Baradaran Firouzabadi[2*], A. Gholami[2] and H. Makarian[2]
[1]Ph.D. Student in Agronomy, Shahrood University of Technology
[2]Associate Prof. in Agronomy, faculty of Agriculture Shahrood University of Technology

Received: 28-4-2019 Accepted: 27-11-2019

Abstract

Background and objectives: Soybean is an important source of oil and protein human and animal protein. The main part of the growth period of this plant is in the summer, which is usually exposed to stresses such as heat, dryness and even salinity, and finally, there would negatively affect the growth and yield of these plants. It can be inferred that it may be possible to use external component to reduce the negative effects of stresses on plants and to increase yield and product quality. Considering the positive anti-tension properties of vitamins in group B and melatonin, it can be concluded that by applying these materials on soybean as a solution of positive effects, the growth and yield of physiological improvement, especially in summer conditions, can be obtained. Therefore, in this research, the effect of these materials on soybean on DPX cultivar, physiological and qualitative aspect was investigated at Shahroud University of Technology Research Field.

Materials and methods: Treatments including melatonin foliar application (0, 0.1 and 0.2 mM) and vitamines B group (0, thiamine, riboflavin, niacin, pantothenic acid and pyridoxine 100 mg/ L) were organized in factorial experiment on the basis of completely randomized block design in three replications.

Results: The effect of melatonin and vitamin B on leaf area index, stem height, stem diameter, number of seeds per pod, 1000 seed weight, yield, oil yield, and protein content, leaf dry weight, stem dry weight, and reduction of leaf chlorophyll degradation was significant. The most effective on the traits were related to the combination of 0.2 mM Melatonin and Pantothenic Acid. The foliar application of these two substances reduced the chlorophyll degradation process and increased about 2 times the chlorophyll residue compared to the control. There were no significant differences in B vitamins in the two levels of 0 and 0.1 mM melatonin in terms of the effect on this trait and the effect of 0.2 mM melatonin was higher. There was a significant difference between the levels of B vitamins in terms of leaf area index. Pantothenic acid and pyridoxine were more effective than others. The lowest amount of seed oil yield was obtained in non-foliar application treatment with an average of 21 g / m2, which showed a significant difference with all the treatments. The use of B vitamins with a concentration of 0.2 mM of melatonin showed the highest levels of oil yield, the highest amount of which was related to the combination of Pantothenic acid and high concentrations of melatonin with an average of 106 g / m2.

Conclusion: In general, it can be concluded that the use of melatonin with vitamines B group can induce tolerance to the plant. Therefore, it is possible to use melatonin and vitamin B to increase the growth indices and soybean yield components.

***Keywords*:** Agronomic Traits, Oil, Protein, Vitamin B

*Corresponding author; m.baradaran.f@gmail.com

EJCP., Vol. 12(3)
http://ejcp.gau.ac.ir
DOI: 10.22069/ejcp.2019.16659.2240

Study the relationship between seed and oil yields with some morphological traits in sesame by multivariate analysis

M. Ghasemipanah[1], R. Aminian[2*], M. Gholamhoseini[3] and F. Habibzadeh[4]

[1]MSc. graduated Student, Department of Genetics and Plant Breeding, Faculty of Agriculture and Natural Resources, Imam Khomeini International University, Qazvin, Iran.

[2 and 4]Assistant Professor, Department of Genetics and Plant Breeding, Faculty of Agriculture and Natural Resources, Imam Khomeini International University, Qazvin, Iran.

[3]Assistant Professor, Seed and Plant Improvement Institute, Agricultural Research, Education and Extension Organization (AREEO), Karaj, Iran.

Received: 18-5-2019 Accepted: 25-9-2019

Abstract

Background and objectives: More than 90% of the total oil consumed in the country is imported abroad. Therefore, the development of oilseed cultivation and research programs in this field should be considered. Water deficit stress is one of the most important environmental stresses that has limited the successful production of crops, especially in dry and semi-arid regions. Sesame is one of the most important seed economical products that has good compatibility with dry and semi-arid regions such as Iran. Since yield is a bit complicated trait and controlled by a large number of genes, the effect of each gene is small and environmental factors can have a great effect on it. Therefore, identifying yield components that have more inheritance than yield and, on the other hand, have high correlation with it, can increase the efficiency of selection. So in breeding programs, it is important to examine the components of yield and how they affect each other to achieve high yield. One of the methods for analyzing the components of yield is stepwise regression. In this method, traits that have the greatest share in explaining the variation of yield are distinguished among a large number of traits. Identifying the appropriate and effective traits of yield can be the basis for selection in breeding programs and can be used to increase grain yield.

Materials and Methods: This research was conducted as split plot based on a randomized complete block design with three replications in the research field of seed and plant improvement institute, agricultural research, education and extension organization of Karaj, in summer of 2016. Two factors including irrigation regimes (as main factor) and cultivars (as sub factor) were investigated. Two irrigation regimes including irrigation after 40% soil moisture utilization in soil (no stress) and irrigation after 80% moisture utilization in soil (drought stress) in main plots and 6 sesame cultivars named Halil, Dashtestan 2, Darab 1, Oltan, Yellow White and Naz tak shakheh in sub plots were considered. Correlation analysis, stepwise regression, principal components analysis and path analysis were used to analyze the components of yield. Correlation analysis, stepwise regression and path analysis were performed using SPSS software version 23, principal components analysis and two-dimensional diagram (bi-plot) with Minitab software version 17. The measured traits included seed yield, dry weight of plant, height, number of secondary branches, number of capsules per plant, number of seeds per capsule, 1000 seed weight, seed oil percentage, oil yield, seed protein percentage and seed protein yield.

Results: In both non-stress and drought stress conditions, the highest positive and significant correlation was observed between seed yield and oil yield. In non-stress condition, seed number

*Corresponding author; roghayehaminian@yahoo.com

per capsule and number of capsules in the plant and seed oil percentage were the most effective positive variables on seed yield. 1000 seed weight had the most direct positive effect on seed oil percentage. In stress condition, seed protein percentage and number of secondary branches had the highest negative effects on seed yield, respectively. Seed protein percentage had the most direct positive effect on oil percentage. The main components analysis showed that in non-stress condition, seed yield, capsule number, oil yield and protein yield had high correlation with the first component and 51.1% of the variation was explained. Based on this component, Oltan and Dashtestan 2 cultivars were better in terms of seed, oil and protein yield than other cultivars. In drought stress condition, seed yield, oil yield and protein yield had high correlation with the first component and explained 37.5% of the variation. Halil, Oltan and Yellow White cultivars were not desirable on the basis of this component, which was the component of seed, oil and protein yield.

Conclusion: With increasing seed yield per area unit, oil yield and protein yield per area unit also increase, so increasing the yield of oil should be increased by increasing the seed yield by its effective components. In non-stress conditions, by increasing the number of seeds per capsule, the number of capsules in the plant, the weight of 1000 seeds and the percentage of oil, high yielding cultivars can be achieved. Since the number of secondary branches under drought stress conditions had a negative effect on seed yield, selection of cultivars with lower number of branches of Darab 1 and Dashtestan 2 could lead to higher seed and oil yields under water stress conditions.

***Keywords*:** Path analysis, Principal components analysis, Stepwise regression, Stress