

Optimization of irradiation of Mung bean seeds with ultrasound for increased seedling vigor components, using genetic algorithm

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Abstract

Background and objectives: The complete (C), rapid (R) and uniform (U) germination of vigorous seedlings (V) are properties which all together (CRUV) cause early canopy closure and consequently increase plant yield. The probable no strong positive relation (correlation greater than +0.95) between one or some components of CRUV causes that one treatment level appears to be the best treatment level for increasing of one or some components of CRUV, but the worst or medium for other components. In such situation it is hard to select one treatment level (Judgment predicament). Genetic algorithm-based optimization as a complementary analysis is a solution (overcoming the predicament) to such problems by which the treatment levels are interpolated for possible simultaneous maximum increase in CRUV. This experiment was firstly aimed to find whether there is Judgment predicament or not? Secondly, in case of positive answer, it was aimed at finding the best components of ultrasonication (as increasing treatment for CRUV) of Mung bean seeds. The components of ultrasonication were seed pre-soaking, ultrasonication temperature, and duration of ultrasonication.

Materials and methods: The mean values of CRUV of 10 published papers were subjected to correlation analysis. Then a germination experiment based on completely randomized design with 3 replications was conducted for Mung bean. Treatments were factorial arrangement of seed pre-soaking (2, 4, 6, 8, 10, 12 hours), ultrasonication temperature (17, 22, 27, 32 °C), and ultrasonication duration (0, 3, 6, 9, 12 minutes). Due to no strong relation between all components of CRUV, the genetic algorithm was used to optimize them. For this reason, firstly the desirability function was calculated; then the value of general desirability was determined. For predicting the response variables, different linear and non-linear functions were examined among which, the quadratic multiple regression function was found to be more appropriate. Finally, the best combination of experimental factors for possible simultaneous increase in CRUV was interpolated, using MATLAB software.

Results: The results indicated that like those plants mentioned in published papers which their CRUVs were reviewed here, there was no strong positive relation between all components of CRUV in Mung bean. Therefore, the judgment predicament tends to be true in Mung bean too. The result of analysis of variance revealed that in addition to main effects, the triple interactive effects of factors were significant on each components of CRUV. The interpolated value of factors was ultrasonication temperature of 24.89 °C, ultrasonication duration of 4.125 minutes, and pre-soaking of seeds for 6.013 hours. This combination of factors could result in the highest possible increase in CRUV simultaneously.

Conclusion: Based on the results of this study, it seems that the judgment predicament tends to be widespread over all plants. In such situation, as it was seen in Mung bean, the value of treatment combinations (or treatment level) is not the same for having simultaneous increase in

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all components of CRUV. The optimization as complementary analysis beside the mean comparison analysis, can estimate the best treatment level (mono-factor experiments) or treatment combination (multi-factor experiments); due to such simultaneous increase in CRUV, the canopy closure will be accelerated.

Keywords: Seedling vigor, irradiation temperature, pre-soaking, ultrasonic waves.

Stochastic climatological yield forecasting of four crops wheat, barley, potato and maize in East and West Azerbaijan Provinces for development of agricultural planning

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Abstract

Background and objectives: A reliable forecast of crop yield has more importance regard to the policy decision of agricultural programming. Also, the main concern of developing countries is the knowledge about the crop yield values with emphasis on the effective factors of yield. The aim of this study is the yield forecasting of some crops based on the climatological, stochastic aspects. The hybrid method is the combination of two climatological and stochastic aspects.

Materials and methods: The efficiency of three aspects regard to the yield forecasting of wheat, barley, potato and maize in East and West Azerbaijan Provinces (Tabriz, Jolfa, Maragheh, Ahar, Mianeh, Urmia, Maku, Khoy, Mahabad, Maku) were evaluated in the time period 1987 to 2016. Crop yield estimation with the climatological aspect was conducted basis on the significant climatological data using the regression analysis. The determination of effective data regard to the crop yield was basis on the significant correlation coefficient of crop yield and meteorological data. The Auto Regressive Integrated Moving Average (ARIMA) model has been applied for the time series analysis. In the stochastic aspect, the time series modeling was based on the preliminary analysis, identification, estimation, diagnostics steps. The differencing method has been used for stationary of time series. In the final aspect, the meteorological data are estimated basis on the stochastic aspect and then crop yield are estimated using regression analysis.

Results: The effective meteorological data were the total sunshine hours, minimum relative humidity, maximum and minimum of temperature, mean wind speed, maximum relative humidity and mean daily temperature. The preliminary analysis of time series is checking the presence of trend and normality of time series. The time series of crop yield were normal based on the probability plot of time series. The models are passed the diagnostic step such as normality and independency of residual are introduces as the selected models: East Azerbaijan Province: wheat: ARIMA(0,1,1), barley: ARIMA(1,1,1) , potato: ARIMA(0,1,2), maize: ARIMA(3,1,2), West Azerbaijan Province wheat: ARIMA(0,1,3),maize: ARIMA(1,1,1). The comparison of average error criteria for all crops in two provinces indicated the 47.08% RMSE decreasing from regression analysis to stochastic, 21.16% from hybrid to stochastic, 49.53% MAE decreasing from regression analysis to stochastic, 30.32% from hybrid to stochastic. The results of simulation in most cases are overestimated except for maize and potato of regression analysis and hybrid which are underestimated. The average of MARE and NRMSE of three simulated methods for all crops indicated that the minimum and maximum error was related to the potato and wheat, respectively. In this case, NRMSE and MARE decreasing from wheat to potato was 44.68% and 41.66%.

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Conclusion: Food supply for growing population without the sustainable agricultural development is not possible. The significant increasing trend of maximum, minimum temperature and wind speed time series can be due to the climate change which the effects of that can be observed in the water balance of Lake Urmia. According to the little research on the crop yield estimation using stochastic aspect in Iran, the time dependency modeling and trend analysis of time series improved the results. The hybrid method is highly effective when the involved parameters are accurately estimated. In the hybrid method, it must be considered a range of precision in the crop yield estimation which the mentioned range can be increased the accuracy of hybrid model. The optimization of coefficients estimation can increase the efficiency of method.

Keywords: Forecasting, Aspect, Hybrid, ARIMA.

Effect of irrigation methods and nutrient stratification on yield and yield components of rice cultivar “Keshvari”

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Abstract

Background and objectives: Water management in agriculture and rice cultivation can greatly reduce the constraints and problems caused by water scarcity. Irrigation has a significant role in rice yield and rice yield components, and any water stress reduces filling percentages Grain and eventually reduce grain yield. Regarding recent droughts, lack of water resources at the country level, inadequate water in different stages of rice growth and, finally, reduction of rice yield, it is necessary to have proper planning, suitable irrigation management from existing sources and nutrient foliar application, to maximize resources efficiency and achieve optimal yield. This experiment was conducted to evaluate the effect of different irrigation methods on yield and yield components of rice (*Oryza sativa* L.) an experiment was conducted at Rice Research Institute of Iran (Mazandaran - Amol) in 2017.

Materials and methods: This study was conducted as split plot based on randomized complete block design with three replications on the Keshvari rice cultivar. Treatments included different methods of irrigation at three levels (flushing, wet and drying and saturation) as the main factor and nutrient foliar application with five per thousand concentration in six levels (water, nitrogen, nitrogen + potassium, nitrogen + potassium + zinc, nitrogen + potassium + zinc + boron and nitrogen + potassium + zinc + boron + molybdenum) as a sub-factor.

Results: The results of ANOVA indicated that the irrigation factor had significant effect on grain yield and biological yield at 1% level and did not have significant effect on other traits. Foliar application factor did not have significant effect on traits. The interaction effect of irrigation and fertilizer was significant based on paddy yield in 5% probability level and in terms of biological yield was significant at 1% level and there is not observed significant effect on other traits. The interactions of two irrigation and fertilizer treatments showed that the highest yield of rice with an average of 7284 Kg ha⁻¹ and the lowest with average 4690 Kg ha⁻¹, respectively, was related to watering irrigation under nitrogen + potassium spraying and irrigation and drying with water spraying conditions.

Conclusion: In general, the results of this experiment showed that the paddy yield in saturated irrigation increased by 1.15% and in AWD irrigation decreased 11.85% compared to traditional flooding irrigation. Water saving in AWD irrigation and saturation were 26.4% and 9.9%, respectively, compared to waterlogging irrigation. The highest grain yield was obtained in N + K combination fertilizer application in saturated irrigation. Considering the results of this research, wet and drying irrigation method and saturation methods based on preference could be applied in rice irrigation in condition similar to this research.

Keywords: Rice, irrigation methods, yield and yield components

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The effect of doses and application time of EPTC on weeds control and tuber yield of potato

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Abstract

Background and objectives: Weeds have a significant role in reduce yield of crops and the effect of herbicide application has been proven on increasing crop production. Selection of herbicide that can properly control weeds, is very important. Because the herbicides and the diversity of the sites of action are limited in potato filed so herbicide resistant is not far and that is increasing. Therefore, it is necessary to use herbicide that can control weeds and alternate with other herbicides in potato fields. Also, in this research, the best dose and application time of EPTC at different growth stages of potato is determined.

Materials and Methods: An experiment was conducted in order to evaluate the effect of dose and application time of EPTC in Agricultural and Natural Resources Research Station in Alarog, Ardebil, in 2013. The experiment was conducted as factorial in a randomized complete block design with three replications, two factors with potato Agria cultivar. The first factor was the different doses of EPTC herbicide in six levels of 500, 1000, 2000, 4000, 5000 and 6000 g a.i/ha and the second factor, the application time in three stages of pre-plant, potato emergence and stoloning was carried out. Three weeks after spraying in each stage of growth stages, weed density and biomass were evaluated. Data analysis carried out by SAS 9.1 software and Sigma Plot 11 software was used for graphs. Mean comparison was by using the least significant difference test at the 5% probability level.

Results: Statistical analysis showed that interaction effect of doses and application time of EPTC is significant on weed density and biomass. EPTC at 6000 g a.i/ha in the pre-plant stage reduced 84% of total weed density. According to the results of this study, the highest percentage of biomass reduction was observed in treatment of 6000 g a.i/ha EPTC and pre-plant stage of potato. Among different weed treatments, application 5000 and 4000 g a.i/ha of EPTC at pre-plant and potato emergence are next rank. The highest mean weight of the tuber and total tuber yield were obtained using EPTC herbicide at 6000 g a.i/ha in the pre-plant stage. The use of EPTC herbicide in the pre-plant increased its yield to 35.04%.

Conclusion: According to the results, the best treatments for reducing of weed density and biomass weed is 6000 g a.i/ha in the pre-sowing. With the application of these treatments, the mean weight of the tuber and the total tuber yield of potato increased.

Keywords: Eradican, Pre-sowing, Weed biomass and Weed density

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Effects of sowing date and nutrition management as organic, chemical, biological and nanotropic in Chickpea Yield

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Abstract

Background and objectives: Nano and biological fertilizers are considered as a suitable ecological strategy to increase the availability of elements for plants. Thus, in these methods, the plant was able to absorb the highest amount of nutrients which result in high yield. Also application of nitrogen and phosphorus Bio-fertilizers due to the prevention of water and soil pollution, it is a good alternative to chemical fertilizers and has a positive role in the stability of the system. The present study was conducted to investigate the response of chickpea (Hashem cultivar), affected by different nutrition management as organic, chemical, biological and nanotropic and Autumn and spring sowing dates.

Materials and methods: The research was carried out in Research Farm of Maragheh University with Geographical coordinates 37°23' N; 46°16' E and 1485 meters above sea surface in northwest of Iran, during 2016-2017 growing season as Split-plot experiment conducted based on a randomized complete block design with three replications. The main factor included sowing date (S1: spring sowing, S2: winter sowing) and sub factors included fertilizer treatments F₀: control (no fertilizer application), F₁: NPK fertilizer (20-20-20), F₂: animal manure Twenty tonnes per hectare, F₃: Nano-fertilizer, super-micro-structure, F₄: Pre-plant bacterial inoculation with biofertilizer P (containing *Pantoea gglomerans* strain P5 and *Pseudomonas putida* strain P13) and nitrogen fertilizer (*Azotobacter vinelandii* strain O4), F₅: nano chelated zinc + iron + manganese fertilizers. Parameters such as plant height, biological yield, shoot fresh weight per plant, shoot dry weight per plant, number of pods per plant, number of unfilled pod per plant, number of grain per plant, grain protein (%), 100-grain weight, grain yield were evaluated.

Results: Results showed that the effect of fertilizer treatments were significant on shoot fresh weight per plant, shoot dry weight per plant, number of pods per plant, seed yield, biological yield, 100-seed weight, seed protein percent, seed number per plant; and the height of the plant and the number of hollow pods per plant were not significant. Bio-fertilizer increase grain yield about 14.31%. Also, the number of unfilled pods per plant was not affected by sowing date and interaction effect of fertilizer × sowing date. The effect of sowing date on plant height, shoot fresh weight, shoot dry weight, seed yield, biological yield and number of pods per plant in spring sowing was significantly higher than winter sowing. And spring sowing increase grain yield about 27.5%. However, the number of pods per plant in both sowing dates was statistically similar. Among the measured traits, only 100 grains weight, was affected by fertilizer effect in sowing date.

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Conclusion: Our results showed that the application of nitrogen, phosphorus and bio-fertilizers together in spring sowing date, as the best treatment, could improve vegetative growth, yield and yield components of chickpea through supplying some elements such as N and P and also other environmental sources for this plant.

Keywords: Sowing date, Micro nutrients, Chemical fertilizers, Bio-fertilizers, Chickpea.



Life cycle assessment of ecological footprint of water in wheat production under effect of irrigation interval with application of nano-silicon and nano-potassium chelate in Boushehr region

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Abstract

Background and objectives: According to the previous studies, the basic solutions for solving the problem of water use of silicon and potassium fertilizers, which can be very useful for increasing the tolerance of plants to biotic and abiotic stresses. It has been reported that the use of silicon and potassium, due to mechanical resistance, translates the vertical position into leaves and stems, which in turn increases the light penetration into plant's canopy that the plant can do more photosynthesis. Therefore, this research was conducted with the aim of evaluating the ecological footprint life cycle of wheat production under the effect of irrigation interval with the use of nano-silicon and nano-potassium chelate.

Material and methods: The experiment was conducted as split plots based on a randomized complete block design with three replications at a research farm located in Boushehr during 2016-17. Irrigation interval in four levels were: 1) irrigation interval 2 days (without stress), 2) irrigation interval 4 days, 3) irrigation interval 6 days, and 4) irrigation interval 8 days as main plots and nano-particle in three levels including nano-silicon, nano-potassium chelate and control (no-consumption) were considered as a sub-plot. Nano-silicon spraying with a concentration of 20 ppm was carried out at middle of tillage, the end of tillering and heading stages. Foliar application of nano-potassium chelate was used in middle of tillering and heading stages.

Results: The results of this study revealed that the irrigation interval delayed from two days to eight days leading to significantly decrease of the grain potassium percentage and grain protein content. The highest grain yield (3572 kg.ha⁻¹) was obtained for irrigation intervals of two and four days with nano-potassium chelate consumption, which was due to spike length, number of grain per plant and number of grain per spike. Grain yield with nano-silicon application for irrigation intervals of two to four days were also ranked next. Delayed irrigation reduced the amount of water consumed by 7.35% from two days to eight days. The highest water use efficiency (2.12 kg.m³) was obtained for irrigation intervals of two days. In all four irrigation regimes, the highest water productivity (WP) was obtained with the use of nano-silicon and nano-potassium chelate utilization, which nano-potassium chelate had a more positive effect on WP. Carbon dioxide emission increased by two-day irrigation intervals about 5.47 percent compared to the eight-day irrigation interval, but the land occupation increased about 7.2 percent. With increasing irrigation intervals from two days to eight days, the impact categories of ecosystem quality, resource depletion, agricultural water scarcity, water depletion index (WDI) and water scarcity index (WSI) were decreased about 8.21, 8, 10.89, 9.29 and 9.91 percent. Furthermore, with the consumption of nano-silicon and nano-potassium chelate, the

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resource depletion, agricultural water depletion, WDI and WSI were lower than control treatment. The WDI about 7.28% and 8.24%, and about 9.7% and 8.57% was decreased with consumption of nano-silicon and nano-potassium chelate compared to control treatment.

Conclusion: According to the findings, the best irrigation intervals in terms of improving quantitative and qualitative yield, increasing the water use efficiency and water productivity, as well as reducing the ecological footprints of water was intervals irrigation with two to four days, which were at a statistical level. In all the four irrigation intervals, the quantitative and qualitative yield of wheat increased with the use of nano-potassium chelate and nano-silicon, but the plant's water requirement decreased. Therefore, the consumption of nano-potassium chelate and nano-silicon resulted in increased water productivity, quantitative and qualitative yield and tolerance of wheat plant to water stress.

Keywords: CO₂ emissions, Ecosystem quality, Land occupation, Resource depletion, WP.

The effect of different barley and hairy vetch row intercropping sowing pattern and phosphorus fertilizer on dry matter production and forage quality

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Abstract

Background and Objectives: Biodiversity in agricultural system caused to modifying the pest and diseases populations, also, it could be improved nutrient cycle and soil conservation via activation of soil microorganisms that caused to increasing in soil stability, soil erosion control and increasing in carbon sequestration. Crops and legumes intercropping are a suitable system for increasing food production and reducing environmental impacts. So, one way to achieve sustainability in agriculture is to use multi-cropping and mixes systems. The purpose of this experiment was to investigate the effect of different barley and hairy vetch and phosphorus fertilizer patterns on LER index, dry matter yield and qualitative traits of barley and hairy vetch.

Material and Methods: This research was conducted in experimental farm of Agricultural Faculty of Shahid Chamran University of Ahvaz at 2016-2017 growing season. Experimental design was randomized complete block as a factorial arrangement with three replications. The first factor was 8 planting patterns includes barley sole cropping, hairy vetch sole cropping, hairy vetch-barley intercropping ratios includes 50+50, 25+75, 75+25, as replacement series, 100% barley+10%, 20% and 30% hairy vetch as additive series and mixed intercropping. The second factor was two phosphorus fertilizer type includes 150 Kg ha⁻¹ triple superphosphate and 75 Kg ha⁻¹ triple superphosphate+ biological fertilizer (Barwar2). Dry matter yield was determined by harvesting a 1 m² area from each plot. The measured traits include: crude protein (CP), water soluble carbohydrate (WSC), ash percent, dry matter digestible (DMD), acid detergent fiber (ADF), Neutral detergent fiber (NDF), Intercropping dry matter yield, barley relative yield, hairy vetch relative yield, and land equivalent ratio (LER). The plant density for barley and hairy vetch were 375 and 250 plant/m² respectively. The harvest operation achieved at April in barley dough stage.

Results and Discussions: The results showed the highest total dry matter (1074 gr m²) and LER=1.2 was obtained at 100%barley+30% hairy vetch additive method. The highest crude protein, dry mater digestible (DMD) and ash percent were observed at hairy vetch sole cropping treatment. The highest water soluble carbohydrate, NDF and fiber were found at 100%barley+30% hairy vetch additive method. Biological phosphorus fertilizer+ 75 Kg ha⁻¹ P had the highest CP, DMD, ASH and NDF. But in WSC, CF and ADF, chemical fertilizer was the best treatment.

Conclusion: The results showed that with increasing in hairy vetch ratio in intercropping, the crude protein increased. The barley sole cropping had the lowest crude protein. The comparison of different planting pattern showed that with increasing in barley ratio and decreasing in hairy vetch ratio, WSC, NDF, ADF and CF was increased. Also with increasing in hairy vetch ratio,

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DMD, ASH and CP was increased. Totally the results revealed that the hairy vetch in intercropping caused to increase in total forage yield and quality.

Keywords: Intercropping, Phosphorus fertilizer type, Dry matter quality, Competition, Crude protein

Assessment of land suitability and performance possibility of wheat-soybean rotation in Golestan province

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Abstract¹

Background and objectives: Land suitability analysis is a valuable application of GIS for spatial design and management. Crop rotation as a critical agricultural management is a site-specific approach that farmers implement traditionally. However, suitability of lands for cultivation of two or more crops at different time must be determined scientifically. Kamkar *et al.*, (2014) investigated the land suitability and possibility of canola-soybean rotation for four basins of Golestan province. Results showed that only 11.82 percent of studied lands were suitable for implementation of canola-soybean rotation. Bidadi *et al.*, (2015) studied the land suitability of Qaresoo basin in Golestan province for wheat cultivation. Results showed that wheat cultivation in studied area was categorized in four zone including very suitable, moderately suitable, poor and unsuitable. This research was conducted for agroecological zoning of Golestan province based on cultivation of wheat and soybean and for determining of suitable lands for implementation of wheat-soybean rotation.

Materials and methods: For accomplishment of this research, ecological requirements of wheat and soybean were determined using scientific resources. Minimum, maximum and average temperatures, precipitation, electrical conductivity, pH, soil texture, slope, aspect and elevation were ecological factors for determination of wheat and soybean land suitability. IRS images for 2008 and Landsat five images for 2011 were used to prepare the land use map for wheat and soybean. Possibility of wheat-soybean rotation was evaluated by combination of the suitability maps of wheat and soybean crops.

Results: Suitable arable lands of Golestan province for wheat were classified in four categories (suitable, moderately suitable, poor and unsuitable). Suitable class is 489538.6 ha (67.82% of total province arable lands) which is the highest proportion. For soybean cultivation, arable lands were also classified in four categories (suitable, moderately suitable poor and unsuitable). Suitable class for soybean cultivation is 362192.3 ha (50.17% of total province arable lands). Results showed that arable lands of Golestan province can be classified in 12 categories for performance of wheat-soybean rotation. Suitable-suitable wheat-soybean class with 358514.1 ha (49.74% of the lands) had the highest proportion. In the other hand, the unsuitable-moderately suitable and unsuitable-suitable classes of wheat-soybean rotation with 3.52 and 11.84 ha, respectively comprises less than 1% of the total land.

Discussion: In general, wheat-soybean rotation is conducted extensively in Golestan province despite climatic and management limitations. It is clear that breeding of early maturing cultivars of wheat and soybean is one of the most crucial steps to improve the performance of this rotation. Results revealed that using GIS can be very useful and efficient an important tool for determination of ecological potentials of a crop.

Keywords: Cultivation suitability, Golestan province, AHP.

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Investigating some qualitative characteristics of Rosemary under effect of various foliar application of nutritional compounds and different harvest time

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Abstract

Background and objectives: Rosemary (*Rosmarinus officinalis* L.) is used in perfume and cosmetic industries. It has several medicinal properties like antibacterial, antifungal, anticancer, carminative and nervine spasmodic (Puttanna et al., 2010). Biofertilizers spraying including amino acids, hormones and vermiwash immediately effects and causes to maintaining economic affairs and environmental protection. In general, amino acid stimulus and plant growth regulator can improve uptake of nutrients and increase crop yield and photosynthesis. Vermiwash contains micro plant nutrients, some nitrogen fixing and phosphate solubilizing bacteria, plant growth hormones and amino acids. Also, harvest time influences the effective combination of medicinal plants, because the quantity and quality of plant essential oils vary in different times. Considering the need to manage plant nutrition in order to increase and sustain production and preserve the environment, this examination was carried out to investigate some qualitative and physiological characteristics of Rosemary under the influence of various nutritional compounds spraying at different harvest time.

Materials and methods: This examination was carried out in split plot based on Randomized Completely Block Design with three replications at the Zabol Agricultural Research institution farm in 2015. Harvest time included the autumn's harvest (late autumn), the spring's harvest (late spring) and the second harvest from plants that cut last autumn (late spring) were considered as a major factor. In addition, nutritional compounds spraying including: Aminolforte (1 L.ha⁻¹), Hiumeforte (1.5 L.ha⁻¹), Salicylic acid (200 mg.L⁻¹), Gibberellin (300 mg.L⁻¹), Vermiwash (1 vermiwash: 1 distilled water) as well as the control (distilled water) were considered as subplot factor. The first spraying was in early autumn and the second one was in late winter. Each stage of spraying was applied about three months before their harvest time.

Results: Interaction of autumn's harvest and hiumeforte had the highest protein content (25 mg L⁻¹). By interactions of spring's harvest and gibberellin spraying the maximum of chlorophyll a, oil percentage and its yield (4.05 mg gr⁻¹, 1.98 & 69.66 Kg ha⁻¹), of vermiwash the highest phosphorus and the dry matter yield (7845 ppm & 3683 Kg ha⁻¹), of hiumeforte the maximum of essential oil content and its yield (1.68 & 61/73 Kg ha⁻¹), and spraying of salicylic acid the highest soluble carbohydrates (0.016 mg glu gr⁻¹) were measured in shoot. The maximum amount of catalase (0.016 OD min mg protein), nitrogen (11400 ppm) and potassium (6716 ppm) were obtained in second harvest from plants that cut last autumn and hiumeforte, aminolforte and vermiwash, respectively. Because amino acids are absorbed to leaves more quickly through stomata by spraying and involved in the production of nitrogen, protein, and chlorophylls. Therefore, hiumeforte and aminolforte increased protein, catalase and dry matter yield. Hiumeforte increased the essential oil content and yield by participation in both primary

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and secondary metabolic processes in associated with plant growth and development. Gibberellin has a role in the chloroplast structural and possibly due to the high potential of rosemary, the amount of chlorophyll synthesis is increased. Indeed, gibberellin increased oil yield, due to the ability of assimilation in the production of secondary metabolites. Salicylic acid maintained the high level of carbohydrates in the Rosemary chloroplasts. Vermiwash contains inorganic and absorbable phosphorus and high levels of exchangeable and non-exchangeable potassium (Varghese & Prabha, 2014). As a result, it increased the amount of phosphorus, potassium and dry matter yield in Rosemary, due to the quick and direct absorption.

Conclusion: In general, the spring's harvest and the foliar application of amino acid compounds, due to fresh leaves and optimum environmental conditions for growth and development, had the greatest impact on improving nitrogen, protein, essential oil content and yield. Additionally, the foliar application of vermiwash in the spring's harvest had the greatest effect on increasing dry matter yield and improving phosphorus and potassium of Rosemary.

Keywords: Amino acids, Hormones, Minerals, Percentage of Essential oil, Vermiwash.

The effect of applying organic fertilizer with fish and shrimp origin on some quantitative and qualitative traits of Safflower

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Abstract

Background and Objectives: Oil seeds are important sources of vegetable oils. Safflower seed with 25-45% oil is one of the valuable oil seeds. Nowadays, people are aware of chemical fertilizers harmful effects on the environment. So the application of organic amendments is known as a suitable strategy to increase soil organic matter. One of the methods for utilization of aquatic waste is using them as an organic fertilizer. It is full of nutrients especially nitrogen and phosphorous that can eliminate their deficit in farms and gardens. Chitin found in the exoskeleton of shrimp is the second most ubiquitous natural nitrogenous polysaccharide after cellulose on earth. Huge amounts of fish wastes and shrimp have been abandoned by worldwide seafood companies. So using these renewable waste materials as fertilizer is economically feasible. Since nitrogen and phosphorus are essential elements in safflower growth, applying fish wastes and shrimp which are rich in these elements can improve the quantitative and qualitative characteristics of safflower.

Materials and Methods: In order to investigate the effect of shrimp and fish wastes on safflower, an experiment was conducted in completely randomized design with 13 treatments (3 gr shrimp at the soil surface, 3 gr shrimp mixed with soil, 1.5 gr shrimp at soil surface, 1.5 gr shrimp mixed with soil, 3 gr shrimp + 0.2 gr urea at soil surface, 3 gr shrimp + 0.2 gr urea mixed with soil, 1.5 gr shrimp + 0.2 gr urea at soil surface, 1.5 gr shrimp + 0.2 gr urea mixed with soil, 5 gr fish at soil surface, 5 gr fish mixed with soil, 10 gr fish at soil surface, 10 gr fish mixed with soil, and control) and 4 replications in the University of Nahavand. Number of seed, head diameter, number of flowers per plant, number of branches per plant, 1000- grain weight, oil percentage fatty acid content and type were measured.

Results: The results represent the positive effect of shrimp and fish wastes on the studied traits so that the most head diameter (2.1 cm) was observed in the 1.5 gr shrimp at the soil surface treatment, the most seed number by application of 1.5 gr shrimp mixed with the soil, and the highest amount of 1000-grain weight (39.1 gr) in the treatment of 5 gr fish mixed with the soil. The most oil percentage (25.31%) was produced in 3 gr shrimp + 0.2 gr urea mixed with the soil. The most linoleic acid (73.56%) was produced with using 3 gr shrimp + 0.2 gr urea at soil surface and the most oleic acid (33.22%) and linolenic acid (0.38%) belonged to 1.5 gr shrimp + 0.2 gr urea at soil surface treatment. The highest amount of palmitic acid (11.32%) was created in 3 gr shrimp mixed with the soil and the most content of stearic acid (1.97%) in 10 gr fish at the soil surface treatment.

Conclusion: The results showed the positive effect of fish and shrimp wastes especially shrimp, on all of the studied traits. Also, with the simultaneous application of organic and chemical fertilizers, the highest percentage of oil was produced. Considering the results of this study and in order to reduce the use of chemical fertilizers and to achieve sustainable agriculture purposes,

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we can use abundant fish and shrimp wastes as either an alternative or a complement for chemical fertilizers. Due to abundant sources of fish and shrimp waste in the south of Iran and high resistance of safflower to drought and salinity stress, use of aquatic waste as a fertilizer in safflower cultivation can be the subject of future researches.

Keywords: Fatty acids, Fish and shrimp wastes, Head diameter, Oil seed, 1000-grain weight



(Short Paper)

Evaluation of lentil genotypes for autumn sowing in cold temperate regions under field conditions

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Abstract

Background and objectives: In Iran, lentil cultivation is usually done in spring and rain fed conditions. Sowing in low soil temperature at the end of winter to early spring is one of the problems of spring cultivation in Iran. Grain yield can be increased by replacement lentil cultivation in autumn instead of spring cultivation. The results of a research in Iran showed that autumn sowing with cold tolerant lentil genotypes could achieve the yield of two to six times effective than spring sowing (1). Identification lentil genotypes with cold tolerance potential are one of the suitable strategies for success in autumn lentil cultivation. Therefore, this experiment was designed to select cold tolerant genotypes of lentil in field conditions.

Materials and Methods: In this study, the cold tolerance of 253 lentil genotypes was evaluated in 2015-2016 on Research Center for Plant Sciences, the Ferdowsi University of Mashhad based on augmented designs. Planting was done in the early of November. The lowest temperature during this period was -5.9 °C. During the growing season, the phenologic stages of the plants and the survival percentage were recorded under effect of cold temperature of winter. At the end of the growth season, in five randomly harvested plants, Morphological traits, yield, and yield components were measured and recorded.

Results: The rate of survival percentage (SU %) was varied between 0 to 100%. The highest survival percentage (100%) was observed in MLC8. The maximum grain yield (88 g m⁻²) and biomass yield (535 g m⁻²) were obtained from MLC415. The highest length in a plant (41 cm) was observed in MLC291. The maximum number of filled pods (83 filled pods per plant) and maximum hollow pods (72 hollow pods per plant) were observed respectively in MLC218 and MLC72.

Conclusion: Based on results, 23 cold tolerant genotypes among 253 lentil genotypes with the highest cold resistant in vegetative and reproductive growth periods were identified and selected. However, due to mild winter, the further experiment is necessary for identification of cold tolerance lentil genotypes.

Keywords: Augmented, Freezing, Survival, Yield

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