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Effects of flooding stress in two tillering and stem elongation stages on grain yield and its components in wheat (*Triticum aestivum* L.)

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Abstract

Background and objectives: Approximately 10% of the world's land is affected by flooding. Many of crops, including wheat, are susceptible to flooding stress. The occurrence of flooding stress in wheat inhibit root growth, decrease dry matter accumulation, aging of the leaves before puberty, reduce tillering, production of insect florets, suppress plant height, number of spikes and number of grain per spike, decrease biological yield, 1000 grain weight and ultimately grain yield. Accordingly, this study was carried out to evaluate the effects of flooding on grain yield and its components during tillering and stemming of wheat in two Morvarid and Koohdasht cultivars.

Materials and methods: To conduct this research, a pot experiment was conducted in a completely randomized block design with factorial arrangement in Gorgan University of Agricultural Sciences and Natural Resources in 2016. The experimental treatments consisted of the duration of stress period at five levels (0, 7, 14, 21, 28 days) as the first factor, the time of flooding based on developmental stages (tillering and stem elongation) as the second factor, and the cultivars (Morvarid and Koohdasht) were considered as the third factor. In order to apply flood stress, the pots for each treatment were placed inside a pond filled by water, so that up to 2 cm from the stems were submerged. After applying stress treatments, traits such as leaf area, root and aeral dry weight (stem+leaves) number of spikes per plant, number of seeds per spike, 1000 grain weight, biological yield, grain yield and harvest index were measured. Also, linear and nonlinear functions were used to describe the relationships between measured traits and flood duration.

Results: The damages of flood stress in wheat depend on the duration of stress, the developmental stage where the stress coincides with it, and the type of cultivar. In this study, characteristics such as leaf area, root and areal dry weinumber of spikes per plant, number of grain per spike, 1000 grain weight, grain yield, biological yield and harvest index were significantly decreased by increasing the duration of flooding. The changes in some of the traits such as leaf area in Koohdasht cultivar, number of grain per spike in both cultivars, 1000 grain weight in Morvarid cultivar, and biological yield in both cultivars, well fitted by a segmented equation. So that in the first stages, despite the increasing duration of flooding, each of these traits was fixed and unchanged, but, its value was linearly decreased by increasing duration of flooding to more than a certain limit for each trait. In other cases, the traits were reduced linearly from the beginning by increasing the duration of flooding. On the other hand, the number of grain per spike, grain yield, biological yield and harvest index in Kohdasht cultivar were always higher than Morvarid cultivars in different flooding treatments. Also, grain yield

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under stress conditions at stem elongation was always less than when stress was applied to the tillering stage. However, after 28 days of flooding, there was no significant difference between grain yield in two developmental stages at which stress was applied. Grain yield reduction after 28 days of flooding in Morvarid cultivar at two tillering and stem elongation stages was 88.56 and 89.70%, respectively, and in Koohdasht cultivar was 75.90 and 84.62%, respectively. Therefore, the percentage of yield reduction at the time of applying stress at stem elongation was more than that of tillering stage. Grain yield in Kuhdasht cultivar during the stress period was always higher than the Morvarid cultivar.

Conclusion: The duration of stress period was the most important factor affecting the yield. Regarding the fact that the grain yield of wheat began to decrease with the increase in the duration of the flooding period from the beginning (with a gradient of 0.06 – 0.08 g. plant^{-1} per day), the sensitivity of this plant is very high to the flooding stress. The developmental stage and cultivar were ranked second and third in terms of importance, respectively. Therefore, due to the fact that Golestan Province is prone to flooding stress during tillering and stem elongation of wheat, measures such as drainage in the fields or to direct run-off in order to prevent flooding in the fields and thereby yield losses is absolutely necessary.

***Keywords*:** Biomass, Developmental stage, Duration of flooding, Leaf area.

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Effect of time and intensity of defoliation on quantitative and qualitative characteristics of soybean (*Glycine max* L.) under application of amino acids (Nutramin-WSP)

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Abstract

Background and objectives: Soybean (*Glycine max* L.) is an important industrial legume as human and animal feed in the world with an average of 18-22% oil, 38-56% vegetable protein in its seeds. Soybean is one of the most important oilseeds that are the second most important energy source after cereals. In oilseed plants such as soybean, leaves are the first source of photosynthetic material needed to fill seeds, and any reduction or inefficiency of them decrease the transfer of photosynthetic materials to the seeds, resulting in reduced yields. Amino acid compounds affected the enzyme activities of that affect the absorption and application of nitrogen in the plant and increase the protein content in the plant. The aim of this study was to investigate the role of controlling effect of foliar application of amino acids in defoliation during different growth stages of soybean and its effect on quantitative and qualitative yield.

Materials and methods: In order to investigate the effect of time and intensity of defoliation under application of amino acid condition, a factorial experiment was conducted based on randomized complete block design with three replications in Aliabad Katoul, Golestan Province, Iran, during 2016-17. The first factor included the defoliation intensity at three levels of 0, 50 and 100%, the second factor included the defoliation time in five levels (based on growth stages: V1, V3, V5, V7, and R1), and the third factor was the application and non-application of amino acids. Amino acid spraying with the recommended rate 1 kg per 1000 liters of water (250 g/ha) was carried out in V3, V5, V7, and R1 growth stages. The amino acid used by the Nutramin-WSP brand is Biomega, which contains 14-15% nitrogen, 0.3-0.7% calcium, 0.4-1.2% phosphate, 1.1-1.5% potassium, 0.3-0.6% ammonium, and 90% amino acids.

Results: The results showed that the effect of amino acids, the time and intensity of defoliation, and the interaction between times in intensity of defoliation were significant on oil yield. Application of amino acid resulted in an increase of 98.9% of oil yield compared to the non-application treatment. The highest oil yield was observed in the defoliation of 50% leaf in V1 stage with a mean of 867.5 kg/ha, which was 10.5% higher than to the control treatment. Comparing the mean interactions effects of times in intensity of defoliation, the highest grain protein yield was observed in defoliation of 50% leaf in V5 stage with 1296.17 kg/ha, which increased 17.33% compared to the control treatment. Defoliation of 100% of leaves resulted in the lowest weight of 100 seeds, and the absence of leaf defoliation and the defoliation of 50% of the leaf had the highest mean of this trait. Application of amino acids increased 12.28% of grain yield compared to the non-application. In the interaction of the times in intensity of defoliation,

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the highest grain yield associated with 50% defoliation of leaf in V1 and V5 stages were 3681.9 and 3696.3 kg/ha respectively, which was 2.46 and 2.84% higher than to the control treatment, respectively.

Conclusion: In general, defoliation in late of vegetative growth stage and early reproductive growth stage with 100% intensity was reduced the quantitative traits (yield and yield components) and qualitative traits (oil and protein content of grain). However, 50% defoliation treatment by increasing the remobilization share in the plant resulted in an increase in most of the studied traits. The results showed that the use of amino acids in comparison to improved growth and production of the plant increased the average of most of the studied traits by modifying the effect of defoliation stress, which can be proposed as a solution to this stress.

Keywords: Foliar application, Pod, Seed oil, Seed protein, Seed yield, Source and sink relations.

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Evaluation of Economic Indices, Energy and GHG Emissions in Watermelon Production (Case Study: Ilam Province)

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Abstract

Background and objectives: Efficient use of energy is one of the basic goals of sustainable agriculture. Increasing demand for food has led the Increased consumption of chemical fertilizers, pesticides, machinery and other natural resources, that has is the adverse environmental impacts on water, air and land. Therefore, it is necessary to take measures to increase the efficiency of the use of energy resources and reduce the environmental impact. The purpose of this study was to determine the pattern of energy consumption, greenhouse gas emissions and economic analysis of watermelon production in Chardavol, Ilam province.

Materials and Methods: The information required for this research was collected through questionnaires and interviews in year 97. The sampling method was simple random. The amount of greenhouse gas emissions in the watermelon production system was calculated using the CO_2 equivalent coefficient for different inputs. Energy indices included energy ratio, energy efficiency, energy intensity, and net energy. The energy ratio represents the ratio between the caloric value of the output products and the total energy consumed in the production factors. This indicator is dimensionless and shows the amount of energy obtained per unit of energy consumed for production. Energy intensity represents the energy consumption to produce one unit of product. This indicator varies depending on the type of crop, location and time, and can be used as an indicator to evaluate energy efficiency in different production systems. Energy efficiency is the inverse of energy intensity and is obtained by dividing the amount of product produced by the energy consumed and, in fact, expressing the amount of product output per unit of energy consumed. In these relationships, unit energy ratios, output energy in (MJ/ha), input energy in terms of (MJ/ha), energy efficiency in terms of (Kg/MJ), energy intensity in terms of (MJ/Kg), total The crop produced in the period was in Kg / ha and net energy added in MJ / ha. Also, the calculation of economic indices was estimated based on gross income indices, gross output value, fixed and variable costs, yield, product price and profit-to-cost ratio. $SPSS_{25}$ and Exel software were used for data analysis.

Results: The results showed that the two inputs of irrigation water and diesel fuel were %36.01 and %25.21, respectively. Total input and output energies in watermelon production were calculated 38584.89 and 781115.93 MJ/ha. The ratio of energy, energy efficiency, energy intensity and net added energy were estimated as 2.02, 1.06, 0.93 and 39531.04 MJ, respectively. Total greenhouse gas emissions were 1151.4 kg CO2/ha, the highest amount of which was related to livestock manure and diesel fuel with 489.6 and 476.7 kg CO2, respectively. The profit-to-cost ratio was 3.85.

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Conclusion: According to the study, the highest energy consumption is related to irrigation water and diesel fuel. The highest greenhouse gas emissions were related to the use of animal manure with 489.6 kg followed by diesel fuel with 476.79 kg carbon dioxide equivalent. Therefore, it is recommended to conduct researches on applying conservation and low tillage methods to reduce fuel consumption and greenhouse effects of fuel consumption. Also, since the profit-to-cost ratio of 3.85 was calculated, watermelon production is economically justified, but attention to the water issue is essential in locating the crop.

***Keywords*:** Ilam, Economy, Energy, Sustainable agriculture, Watermelon.

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Evaluating of genetic diversity of Datura (*Daturea stramonium* L.) genotypes on the basis of morphological characters

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Abstract

Background and objectives: The biotypes or ecotypes of a species are usually different in terms of growth, morphology, and susceptibility to herbicides. When different genotypes of a species are exposed to environmental changes, they show different degrees of developmental diversity. Tatura is an annual plant, a broad leaf herbaceous plant that reproduces only through seeds and overwinters only as seeds. Awareness of the genetic diversity of this weed can lead to the development of management programs to control this weed. Since there is little scientific information on the study of genetic diversity of Daturea based on morphological method, which is a common and first step in genetic studies. In this study, genetic diversity was investigated among six genotypes of Daturea collected from different parts of the country based on morphological traits.

Materials and methods: This study was conducted in the research greenhouse of Agriculture Faculty of Mohaghegh Ardabili University in 2017. Seeds of six genotypes of Daturea were collected from Tehran, Mashhad, Gilan, Ardebil, Hamadan and Moghan . The experiment was performed based on a completely randomized design with six genotypes and three replications. Traits related to vegetative organs were measured at flowering stage and boll traits at boll stage.

Results: According to the results of analysis of variance difference between the genotypes studied traits has a significant effect on the average leaf length, the average leaf width and number of seeds per head at 1% probability and on the main stem height, internode length, angle and leaf area index average at 5% probability. The estimated correlation coefficients showed that the highest correlation there was between fresh weight with total plant fresh weight (r= 0.98) and least correlations between dry weight and number of seeds (r= -0.92). Factor analysis for all traits, showed five hidden factors that Justified 99.98% of the total variation. On the basis of cluster analysis, six studied populations were in two groups. The first group consists populations Ardebil, Hamedan, Mashhad and Moghan and the second group populations Gilan and Tehran.

Conclusion: On the basis of cluster analysis, six studied genotypes were in two groups. The first group consists genotypes Ardebil, Hamedan, Mashhad and Moghan and the second group genotypes Gilan and Tehran. The genotypes of each group were similar in some morphological traits. Morphological differences between two groups may affect their competitive power and may be effective in response to chemical and agronomic management method. When a herbicide comes into contact with the plant, its action will be affected by the morphological and

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anatomical traits of the plant as well as the numerous physiological and biochemical processes that occur within the plant. Morphological diversity of Daturea genotypes can justify their adaptability to different environmental conditions and different methods of weeds management.

***Keywords*:** Cluster analysis, Correlation, Diversity, Factor analysis.

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The critical period of weed control in dry-land conditions of Kurdistan province

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Abstract

Background and objectives: Chickpea has the highest harvest area and production quantity among pulse crops in Iran. This crop is a poor competitor against weeds. So understanding the critical period of weed control (CPWC) is important for determining proper time of weed management and herbicide application. The objective of the experiment was to determine the CPWC of chickpea in dry-land conditions of Dehgolan plain in Kurdistan province.

Materials and methods: The field experiment was carried out as randomized complete block design with four replications at agricultural research station of Kurdistan University in Dehgolan plain, Kurdistan province from April 18, to July 21, 2014. The chickpea cultivar ILC 482 was used for the study. The trial had 16 treatments, including seven non-weeding (Interference) periods and seven weeding (weed-free) periods as well as whole season weed free and weed interference as control. Weed interference and weed-free treatments were set up as 12, 22, 32, 42, 52, 62, and 72 day periods after planting. The beginning and the end of CPWC was determined by curve fitting to weed interference and weed free periods respectively. Relative seed yield of treatments was calculated as percent of weed-free control. A four parameter logistic equation was fitted to relative yields of weed interference and weed-free periods and then CPWC was determined based on 2.5, 5, and 10 percent acceptable yield loss (AYL).

Results: Weed density of interference periods ranged 9.98-17.42 and the mean density was 14.82 plant m^{-2} during growing season. Mean density of *Chenopodium album*, *Convolvulus arvensis*, *Carthamus oxyacantha*, and *Amaranthus retroflexus* were 8, 4, 1.5, and 0.5 plant m^{-2} respectively and composed the major species of weed community. Weeds dry weight increased linearly as interference period increased and reached 62.13 gm^{-2} on harvest time. In contrast, weeds dry weight decreased exponentially with increasing weed-free periods and approximately approached zero at the end of growing season. Seed yield of weed-free and weed interference controls were 106.38, and 68.71gm^{-2} respectively. Therefore, weed interference reduced seed yield by 35.5% compared to weed-free control. The beginning of CPWC was estimated 208, 292, and 426 degree days (18, 24 and 36 days after planting) equal to 3, 5, and 8 chickpea leaf stage and the end of CPWC was also determined 1234, 969, and 720 degree days (79, 67 and 54 days after planting) equal to mead seed filling, the end of podding, and early flowering according to 2.5, 5, and 10 percent yield loss.

Conclusion: The CPWC was determined 24-67 days after planting (the 5 leaf stage to the end of chickpea podding) based on 5% yield loss.

***Keywords*:** Acceptable yield loss, Competition, Interference, Relative yield.

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Evaluation of some biological properties and grain yield of five chickpea cultivars in weed appearance

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Abstract

Background and objectives: In agriculture, weeds are one of the main limiting factors. In fact, the problem of weeds is a basic problem in farms, which can lead to major economical yield losses in agriculture. Weeds can decrease soil nutrients and can threaten crops by competition for water, nutritions and light. Chickpea (*Cicer arietinum* L.) is one of the earliest cultivated legumes and 7500-years old remains have been found in the Middle East. It plays an important role in human nutrition as a source of protein, energy, fiber, vitamins, and minerals for large population sectors in the developing world. The weeds in chickpea fields in some cases has caused a 90% decrease in yield. This research was conducted to evaluation of some biological properties and grain yield of five chickpea cultivars in weed appearance in natural conditions.

Materials and methods: The experiment was conducted at the Research Farm Bu-Ali Sina University (latitude 35°1' N, longitude 48°31' E and 1690 m altitude) during 2013 and 2014 growing seasons. Experiment was conducted as factorial based on randomized complete block design (RCBD) with three replications. Experimental treatments included weed control (weeding and non-weeding) and chickpea cultivars (Tork, Hashem, Arman, Azad and Mahali). The total amount of rainfall during the experiment in the first and second years was about 76 and 80 mm, respectively. The evaluated chickpea traits were plant height, leaf area, branches number per plant, biological and grain yield, chlorophyll index and nodule number and weight. Analysis of variance was used for statistical analyses (Version 9.2, SAS). Differences between treatments were compared by least significant difference (LSD) test at 5% probability.

Results: Analysis of variance showed that the effect of weed control on all traits. Also, the effect of cultivar was significant for all traits except chlorophyll index. The effect of weed control × Cultivar interaction was significant only for on biological and grain yield. The highest plant height, branches per plant, chlorophyll index and nodule number and weight were obtained at weeding treatment and these traits decreased significantly in weedy conditions. The highest grain yield (136.00 g m^{-2}) was obtained at Hashem cultivar in weeding conditions. The lowest value of this trait (33.00 g m^{-2}) with about 75% reduction, was achieved to Mahali cultivar in no weeding condition. Maximum and minimum weed biomass and density was belonged Hashem and Mahali cultivars, respectively. Therefore, results showed that the highest competition index (2.16) belonged to Hashem cultivar, and the lowest value of this index (0.41) belonged to the Mahali cultivar. According to the results of this research, Hashem cultivar can be known as a resistant cultivar against weeds, but against the Mahali cultivar it has the lowest ability against weed invasion.

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Conclusion: The results of this experiment showed that the yield of different cultivars of chickpea were decreased in the presence of weeds. However, yield reduction were not same in different cultivars. As a result, Hashem and local cultivars were identified as a strong and weak cultivar, respectively, in competition with weeds. By evaluating the different varieties of chickpea yield and competitiveness index, can be known which the varieties have good competitive ability in a condition of weed presence, and have the potential in combination with other weed control methods, produce more acceptable yields by lesser need for herbicides.

***Keywords*:** Chickpea, Competition, Plant height, Weed, Yield.

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Investigation of changes in physiological characteristics and yield of Quinoa (*Chenopodium quinoa* Willd) under different cultivation date

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Abstract

Background and objectives: Quinoa is an annual plant belonging to the Amaranthus family with high adaptability in different environments and the only plant food that contains all the essential amino acids, micronutrients and vitamins and has the ability to adapt to different environments. Planting date affects the growth potential and yield of the plant by creating temperature and light restrictions and will reduce or increase plant growth. Proper planting date will produce higher economic yields without increasing additional costs and will allow the plant to show its full growth potential. Plant growth analysis is performed by a series of parameters, the most important of which are leaf area index (LAI), total dry matter (TDM), relative growth rate (RGR), crop growth rate (CGR) and net assimilation rate (NAR). A rapid increase in leaf area and maximum LAI at the beginning of plant life can lead to increas radiation intake, photosynthesis rate, and ultimately increased yield. Crop growth rate is one of the main factors affecting crop production and yield. Various studies on quinoa showed that leaf area index, crop growth rate, relative growth rate and net photosynthesis rate were affected by different planting dates. The aim of this study was to investigate the effect of different planting dates on growth indices and yield of quinoa.

Materials and methods: This study was conducted in the greenhouse complex of Jihad Keshavarzi in Khalil Abad, Khorasan Razavi province, Iran, in the form of a complete randomized block design with three replications and 12 different planting dates during the two crop years of 2018 and 2019. Cultivation treatments were performed once every 15 days from March 6th. During the experiment, the trend of changes in growth parameters including: LAI, TDM, RGR, CGR and NAR was Measured and estimated.

Results: The results showed that the trend of changes in leaf area index in different dates had a slow trend at the beginning of leaf growth period, which continued until shortly before the emergence of flowers, but then the slope of leaf area index increased until the maximum leaf area index continued. With the aging of the leaves, yellowing and shedding of the lower leaves of the plant, due to the shading and re-transfer of material from the leaves to the seeds during the grain filling period, this process decreased and a relatively low decline was observed in the leaf area index. In total, the highest amount of total dry matter in two years was related to the planting date of March 6, but in general, the amount of total dry matter in the second year was less than the first year. Crop growth rate was higher than the planting date on the March 6th in both research years. Crop growth rate in the second year was generally lower than in the first year. This was due to the temperature difference in the two years of study. The relative growth rate during the Quinoa growth season was declining. The net assimilation rate among planting dates did not follow the same pattern, but overall this parameter showed a declining trend from the beginning of the season to the end of the growing season.

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Conclusions: The results showed that the highest values of quinoa growth indices were related to the date of first plantings. This indicated the existence of suitable environmental conditions including suitable temperature and light to better achieve growth indices in the first dates For example, the highest index of leaf area was related to the planting date of March 20 and April 20 during two years of experiment, or other growth indicators had the highest values on March 6th. There was a difference between different planting dates in terms of the amount of growth characteristics studied. In general, the best planting date for this plant in the experimental conditions was from March 6 to April 6.

***Keywords*:** Crop growth rate, Leaf area index, Relative growth rate, Total dry matter.

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Two Sowing and transplanting method effect on peanut (*Arachis hypogea* L.) growth as affected by different row distance in Rasht

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Abstract

Background and objectives: Peanut is one of the most important oilseed plants with indeterminate growth habit, its flowering continues at about 60 to 70 days after emergence, and then flower development will begin to decline. Peanut seed and meal contains a range of 40-50% oil and 30-50% protein on a dry seed basis. A suitable planting method and distance between plant rows can improve photosynthetic process and enhance quantitative and qualitative yield in peanut seed. In the present study, we evaluated the influence of row distance between peanut plant rows and transplanting and sowing method on seed yield and physiological characteristics of peanut new lines under Guilan climatic condition.

Materials and methods: In order to evaluate the effect of row distance and planting method effects on important physiological peanut traits includings of plant height, number of second branch per plant, grain yield, number of pods per plant, 100-grain weight, grain number per pod, dry forage yield, biological yield, grain oil and protein content and harvest index in peanut (NC_2), two experiments carried out in 2017 and 2018 cropping seasons as split plot based on randomized complete block design with three replications in Rasht (49º 57′ N; 37º 26′ E, and 10 m above sea level), Iran. Three row distances (40, 50 and 60 cm) and two planting methods (transplanting and sowing) comprised experimental treatments as main and sub plots, respectively.

Results: Results showed that the interaction effect between row distances and planting method was significant on some agronomic characteristics such as plant height, number of second branch per plant, grain yield, number of pods per plant, 100-grain weight, grain number per pod, dry forage yield, biological yield and harvest index. Based on the results of this experiment, the transplanting method of peanut plants caused it to accelerate the initial stage of flowering. Maximum grain yield (2978 kg ha^{-1}), number of pods per plant (56.65), dry forage yield (4698 kg ha^{-1}), biological yield (9924 kg ha^{-1}) and harvest index (30.02 %) were obtained at 40 cm row distance and transplanting method. Also, the highest grain number per pod (1.33) was obtained

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at 60 cm row distance and transplanting method. Maximum 100-grain weight (57.05 g) was observed at 50 cm row distance and sowing method.

Conclusions: The results indicated that peanut grain yield enhanced in response to decreasing of planting row distance and transplanting method which could be due to improved solar radiance absorption, enhanced of photosynthetic capacity and optimized uses of unit area. Based on the results of this experiment, 40 cm distance between peanut plant rows and transplanting method could be recommendable to enhance peanut seed yield under the region climatic condition.

***Keywords*:** Agronomic traits, Grain oil percent, Grain protein content, Groundnut, Plant density.

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Comparison of yield and yield components of native and improved rice cultivars in transplanting and direct seeding cultivation methods

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Abstract

Background and objectives: Rice (*Oryza sativa* L.) is the most important crop in Gilan and Mazandaran provinces, which is transplanted in puddled soil. This method of planting requires a lot of labor and its production cost is very high. Researches has been shown that rice direct seeding can be a low-cost alternative to transplanting method. Therefore, in this study, the effect of direct seeding on the yield and yield components of different native and improved rice cultivars has been investigated.

Material and methods: This experiment was carried out during 2019 and 2020 in the research farms of the Rice Research Institute of Iran-Rasht. The experiment was a split block based on randomized complete block design with three replications. The main plots included cultivation method in two levels (transplanting and direct seeding) and the sub-plots included rice cultivars in five levels (Hashemi, Anam, Gilaneh, Shiroodi and Taher). Rice density in transplanting method was 25 hills per square meter (each hill contains three seedlings) and seed rate in direct seeding was considered for all cultivars 100 kg / ha.

Results: The results showed that the cultivation method had no significant effect on paddy yield, while the effect of cultivar and interaction of cultivar in cultivation method in the first year of the experiment was significant in this regard. In 2019, the range of paddy yield varied from 4152 kg / ha for Hashemi cultivar in transplanting to 7531 kg / ha for Shiroodi cultivar in direct seeding. In 2020, the lowest (4473 kg / ha) and highest (7842 kg / ha) paddy yield belonged to Hashemi and Shiroodi cultivars in direct seeding, respectively. The effect of cultivation method (in the first year), cultivar and the interaction effect of cultivation method and cultivar on the number of panicle per unit area were significant. In both years (except Anam cultivar in 2020), the number of cultivars panicle in direct seeding was more than transplanting. In 2019, Anam cultivar had the highest (444 panicles) number of panicles in transplanting method, while the number of panicles of this cultivar in direct seeding was 517. In this year, the highest panicle number (626 panicles) in direct seeding method belonged to Shiroodi cultivar, while this cultivar had 332 panicles/m^2. In 2020, Hashemi and Taher cultivars had the highest number of panicles per unit area (456 and 397 panicles, respectively), while the number of panicles of these two cultivars in direct seeding was 606 and 536 panicles, respectively. The effect of cultivation method on the number of filled grains per panicle was not significant. However, in both experimental years, the number of filled grains in transplanting method was 26% and 22% higher than direct seeding method, respectively. This was while the effect of cultivar and the interaction effect of cultivation method and cultivar on the number of filled grains per panicle were significant. The results showed that, biological yield, harvest index and

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number of filled and empty grains in both years of the study had the highest positive correlation with paddy yield.

Conclusion: The results of this study showed that there was no significant difference between direct seeding and transplanting methods in terms of paddy yield. In direct seeding, increasing the number of panicle per unit area led to a decrease in the number of filled grains per panicle, while in transplanting, reducing the number of panicle per unit area led to an increase in the number of filled grains per panicle and thousand grains weight. In fact, significant changes in these yield components in the two cultivation methods led to similar paddy yield in them.

***Keywords*:** Direct seeding, Labor, Paddy, Transplanting.