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Production of Wheat Seed Through Various Plantation Practices in Maternal Environment

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ABSTRACT

Several studies have investigated the effects of maternal environment on various characteristics of seed quality; but no previous study has been done ondifferent plantation practices in maternal environment and its effect on the produced seed quality. Therefore, in the present study, a field and laboratory study was performed aimed at investigating the effect of three various plantation practices (conservation till age (CT), minimum tillage (MT), and no- tillage (NT)) in maternal environment on germination of the produced wheat (*Triticumaestivum* L. cv. Shiraz) seed in the College of Agriculture, Shiraz University (Shiraz, Fars Province, Iran) during 2011-2012 growing season. The results demonstrated that plantation practice significantly influenced grain yield in field; as well as seed germination and seedling growth. CT treatments caused the highest grain weight and yield. The results of laboratory experiment indicated different seed germination and early growth in the seeds developed under various plantation practices. CT as a type of plantation practice in maternal environment significantly reduced characteristics of seed germination, radicle and plumule length, as well as, vigor index of next generation. Although,according to the results, the negative effect of MT and NT on the produced seeds could be an important factor regarding adoption of CT; however this needs to be further studied. Thus, more research is required in this area.

KEY WORDS: CONSERVATION, GERMINATION, MATERNAL FACTOR, VIGOR INDEX.

INTRODUCTION

A decrease has been reported in growth and yield of crops in residues, especially in heavy wheat residues. Reduction of grain yield can be due to several factors including climatic conditions, pathogens in soil, unavailability of nitrogen, toxic effects caused by decomposing of surface residues, and/or poor seedling establishment (Khayatnezhad and Gholamin, 2021a, Gholamin and Khayatnezhad, 2020d, Karasakal et al., 2020b). For conservation tillage (CT), tillage modifications can be used to improve soil conditions. CT practices include the decreased types of plantation practices, such as minimum tillage (MT) and no-tillage (NT) practices, to elevate soil cover with crop residues from the previously cultivated crop (conservation technology information center (CTIC), (Alayi et al., 2020, Arjaghi et al., 2021, Esmaeilzadeh et al., 2020, Aletor, 2021). Improvement of soil surface cover usually leads to enhancement of water uptake and retention. NT as a promising practice for croplands located on the Mediterranean basin can increase water use efficiency (Si et al., 2020).

For achieving yield potential, quality, and also profit in wheat production, attention should be paid to rapid seed germination and uniform emergence of seedlings as essential prerequisites. For achieving an optimal seedling establishment and better productivity, there is a critical need for greater and better synchronized germination (Huang et al., 2021, Farhadi et al., 2020, Fataei, 2017). The two most important environmental problems faced by the crops are unsuitable quality and inadequate germination and establishment. Many factors influence seed quality including cultivar, genetic purity, physical purity, germinability, and vigor index. Although, there are other factors, such as genetic structure, environmental conditions, and maternal environment that highly influence seed quality (Hewitt, 2021).

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Several studies have reported about the effects of maternal environment on different characteristics of seed quality including germinability, dormancy, size, and composition. Temperature, water availability, light (quality and photoperiod), altitude, and mineral nutrition are some environmental factors that have been frequently studied (Li et al., 2021, Huma et al., 2021). However, no study has been conducted about different plantation practices in maternal environment and its effect on the produced seed quality. Thus, in the present study, the effect of different plantation practices (conservation, minimum, and no tillage) was evaluated in maternal environment on seed germination of wheat cv. Shiraz.

MATERIAL AND METHODS

This study was performed in field and laboratory of the College of Agriculture, Shiraz University (Shiraz, Fars Province, Iran) during 2011-2012 growing season. The experimental field was located in a semi-arid region (52° 46'E, 29° 50'N, altitude 1810 m ASL). Table 1 shows physico-chemical characteristics of the soil in the experimental field. The irrigated wheat was cultivated in the experimental site. The treatments were composed of conservation tillage (CT), minimum tillage (MT), and no-tillage (NT). The field and laboratory experiments were arranged in randomized complete block (RCB) and completely randomize design (CRD) types of design, respectively; with three replications in both kinds of experiments. Moldboard plow, twice-disc plow, and leveler were applied in CT treatment. In MT treatment, a combination of tillage tools including sweep plow, disc plow, and roller were used. Row planter was used to sow wheat seeds in CT and MT treatments; while for NT treatment, direct planter was used to sow the seeds.

Row and plant spacing were equal to 20 and 2 cm, respectively; and it was expected to cultivate 2.5 million plants per ha^{-1} (87.5 kg seeds ha^{-1}). Viable wheat seeds (Shiraz cultivar) were sown in plots with dimensions of 3 × 6 m in November 6, 2011. The fertilizer broadcasting was done using 150 kg ha-1 of triple superphosphate at sowing time and also 250 kg ha^{-1} of urea (half of which was used at sowing and the other half was used at stem elongation). Manual weed control was done. Harvesting was performed in June 16, 2012, and grain in each plot was separated for laboratory experiment.

Petri and solution dishes were put in oven for 24 h at 110°C before performing the experiments. Surface of the seeds was sterilized using 5% NaOCl (sodium hypochlorite) for 5 min to prevent fungal invasion, and then, they were washed with distilled water (Karasakal et al., 2020a, Sun et al., 2021). In each petri dish, 25 seeds were placed. Seeds were placed in 9 cm-diameter petri dishes on two layers of filter paper (Whatman No.1). The petri dishes were irrigated with distilled tap water during the experiment. Dishes were put in a germinator at 23 ± 2°C. The filter papers of each petri dish were replaced every 2 days for preventing salt accumulation Muhibbu-din, 2020, Kabir et al., 2021).

Seed germination was recorded daily up to 8th and 15th days after sowing for 25/20 and other regimes, respectively; at the time of lack of germination. Seed germination was considered when radical emerged by about 2 mm in length (Khayatnezhad and Gholamin, 2012b, Karasakal et al., 2020a, Gholamin and Khayatnezhad, 2020a, Sun et al., 2021). In each recording, 10 seedlings were randomly chosen from each petri dish, and sample data were obtained from their averages. The characteristics including germination percentage (Equation 1; (Khayatnezhad and Gholamin, 2020a, Omrani and Fataei, 2018), germination rate (Equation 2; (Omrani and Fataei, 2018)) radicle and shoot length, and vigor index (Equation 3; (Omrani and Fataei, 2018, Ren and Khayatnezhad, 2021)) were measured.

Equation 1: $GP = \frac{n}{N}$ Equation 2: $EI = \frac{\sum n}{Dn}$ Equation 3: $VI = (RL+SL) \times GP$

In Eq. (1); GP is germination percentage, n is number of the germinated seeds, and N is total number of the planted seeds. In Eq. (2); GR is the germination rate, n is the number of the germinated seeds on a specific day, and D is the number of days passed from beginning of experiment. In Eq. (3); VI, RL, SL, and GP are vigor index, radicle length, shoot length, and germination percentage, respectively. Data were analyzed by analysis of variance and significant differences were detected between treatment means by the least significant difference test at $P < 0.01$ level using the SAS v. 9.1 computer software.

Table 1. Some physico-chemical characteristics of the soil in the experimental field

EC (dS m^{-1})	pH	OM (%)	N (%)	P (mg kg^{-1})	K (mg kg^{-1})	Texture
0.62	7.04	1.03	0.25	13.45	693	Silty loam

RESULTS AND DISCUSSION

According to the results, plantation practice significantly influenced grain weight such that, the grains developed in CT treatment were heavier than those in NT treatment; however, there was no significant difference between the developed grains in MT treatment and those of two other treatments (Fig. 1(a)). Although, this difference caused a variation in grain yield between treatments so that, the highest and lowest grain yield were obtained in CT and NT treatments, respectively (Fig. 1(b)). Heavy residues of the irrigated crops left on the soil surface (e.g., in NT) have been indicated to reduce kernel weight of wheat and/or grain yield due to poor crop establishment, disease transmission, and unavailability of nitrogen (Radmanesh, 2021).

Plantation practices in maternal environment influenced germination percentage of wheat so that; CT treatments caused the highest germination of seeds, while seed germination was significantly lower in MT and NT treatments. Germination percentage of wheat seed had no significant difference between MT and NT treatments (Fig. 1(a)). Germination rate in CT treatment was also significantly higher than MT treatment; whereas the lowest germination rate was observed in NT treatment (Fig. 2(b)). Germination and seedling establishment can be mentioned as critical phases in life cycle of many plant species (Gholamin and Khayatnezhad, 2020b, Rodríguez, 2021).

Figure 1: Seed weight (A) and grain yield (B) influenced by three plantation practices in the field

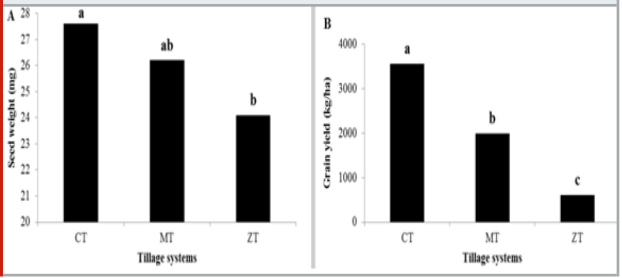
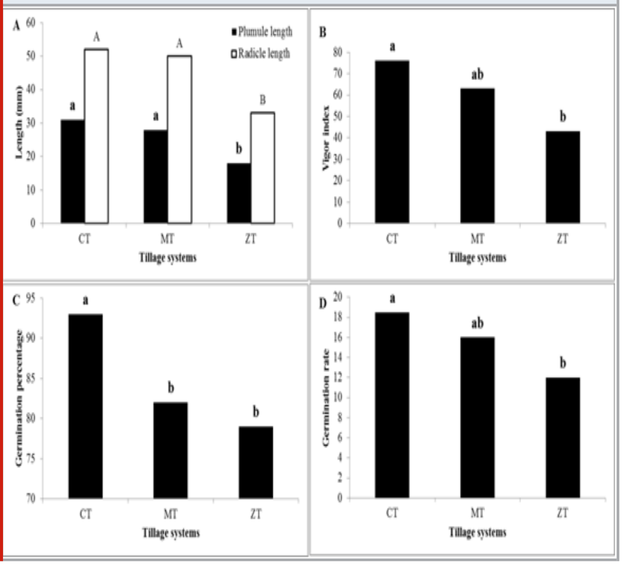


Figure 2: Germination percentage (A) and rate (B), plumule and root length (C),and vigor index (D) influenced by three plantation practices in maternal environment



Maternal environment has been shown to have strong effects during seed development percentage and germination rate in terms of various environmental factors; however no study has been conducted on plantation practices. In the study by Gholamin et al., (2021), it was found that maternal effects were predominant in determination of progeny seed size and germination characteristics. Enhancement of germination rate and percentage in CT treatment could be related to greater storage of seed. Khayatnezhad et al., (2021b) in a study reported early and better germination in heavy seeds, which can be attributed to bigger storage reserves of these seeds.

Higher seedling growth was found in CT treatment, which was not significantly different with MT treatment so that, the highest radicle and plumule length was observed in CT and MT treatments, while the lowest radicle and plumule length was obtained in NT treatment (Fig. 2). Furthermore, similar trend was observed for vigor index, where CT and NT treatments caused the highest and lowest vigor index, respectively (Fig. 3). Greater radicle length might be due to greater seed size. Seed size has been also shown to influence other characteristics of seedling growth, such as plumule length, root and shoot dry weight (Gholamin and Khayatnezhad, 2020c, Khayatnezhad and Gholamin, 2020b).

Based on the results, MT and NT treatments negatively influenced the produced seed so that, the seed developed in these treatments had lower germination percentage and rate. Thus, this effect should be considered along with other disadvantages of CT practices including low temperature in soil surface and incidence of weeds and diseases. Reduction of seed germination and seedling growth under the influence of CT practices could be due to lower seed size (as observed in our study), or higher level of inhibitory components. Thus, more studies are needed to understand these probabilities.

REFERENCES

Alayi, R., Sobhani, E. & Najafi, A. 2020. Analysis Of Environmental Impacts On The Characteristics Of Gas Released From Biomass. Anthropogenic Pollution Journal, 4, 1-14.

Aletor, S. 2021. Environmentally Induced Alternative Livelihood Strategies Among The Artisanal Fishers Of The Kainji Lake Basin, Nigeria. Water And Environmental Sustainability, 1, 1-7.

Arjaghi, S. K., Alasl, M. K., Sajjadi, N., Fataei, E. & Rajaei, G. E. 2021. Retraction Note To: Green Synthesis Of Iron Oxide Nanoparticles By Rs Lichen Extract And Its Application In Removing Heavy Metals Of Lead And Cadmium. Biological Trace Element Research, 1-1.

Esmaeilzadeh, H., Fataei, E. & Saadati, H. 2020. Nh3 Removal From Sour Water By Clinoptilolite Zeolite: A Case Study Of Tabriz Refinery. Chemical Methodologies, 4, 754-773.

Farhadi, H., Fataei, E. & Kharrat Sadeghi, M. 2020. The Relationship Between Nitrate Distribution In Groundwater And Agricultural Landuse (Case Study: Ardabil Plain, Iran). Anthropogenic Pollution Journal, 4, 50-56.

Fataei, E. 2017. Soil Carbon, Nitrogen And Phosphorus Pools Under Exotic Tree Plantations In The Degraded Grasslands Of Iran. Agricultural & Biological Research, 33, 113-127.

Fataei, E., Varamesh, S. & Seiied Safavian, S. T. 2018. Effects Of Afforestation On Carbon Stocks In Fandoghloo Forest Area. Pakistan Journal Of Agricultural Sciences, 55.

Gholamin, R. & Khayatnezhad, M. 2020a. Assessment Of The Correlation Between Chlorophyll Content And

Drought Resistance In Corn Cultivars (Zea mays). Helix, 10, 93-97.
Gholamin, R. & Khayatnezhad, M. 2020b. The Effect Of Dry Season Stretch On Chlorophyll Content And Rwc Of Wheat Genotypes (*Triticum durum* L.). Bioscience Biotechnology Research Communications, 13, 1833-1829.
Gholamin, R. & Khayatnezhad, M. 2020c. Study Of Bread Wheat Genotype Physiological And Biochemical Responses To Drought Stress. Helix, 10, 87-92.
Gholamin, R. & Khayatnezhad, M. 2020d. The Study Of Path Analysis For Durum Wheat (*Triticum durum* Desf.) Yield Components. Bioscience Biotechnology Research Communications, 13, 2139-2144.
Gholamin, R. & Khayatnezhad, M. 2021. Impacts Of Peg-6000-Induced Drought Stress On Chlorophyll Content, Relative Water Content (Rwc), And Rna Content Of Peanut (*Arachis hypogaea* L.) Roots And Leaves. Bioscience Research, 18, 393-402.
Hewitt, E. 2021. Ecological Plunging And Wireless Filming For Science Education: A New Zealand Pilot Experimeent. Water And Environmental Sustainability, 1, 24-29.
Huang, D., Wang, J. & Khayatnezhad, M. 2021. Estimation Of Actual Evapotranspiration Using Soil Moisture Balance And Remote Sensing. Iranian Journal Of Science And Technology, Transactions Of Civil Engineering, 1-8.
Huma, Z., Lin, G. & Hyder, S. L. 2021. Promoting Resilience And Health Of Urban Citizen Through Urban Green Space. Water And Environmental Sustainability, 1, 37-43.
Kabir, K., Arefin, S. M. A. & Hosain, M. T. 2021. Analysis Of Momentary Variations In The Quality Of Water On Specific Criteria In Cole Mere. Water And Environmental Sustainability, 1, 8-12.
Karasakal, A., Khayatnezhad, M. & Gholamin, R. 2020a. The Durum Wheat Gene Sequence Response Assessment Of Triticum durum For Dehydration Situations Utilizing Different Indicators Of Water Deficiency. Bioscience Biotechnology Research Communications, 13, 2050-2057.
Karasakal, A., Khayatnezhad, M. & Gholamin, R. 2020b. The Effect of Saline, Drought, And Presowing Salt Stress On Nitrate Reductase Activity In Varieties of Eleusine Coracana (Gaertn). Bioscience Biotechnology Research Communications, 13, 2087-2091.
Khayatnezhad, M. & Gholamin, R. 2020a. A Modern Equation For Determining The Dry-Spell Resistance Of Crops To Identify Suitable Seeds For The Breeding Program Using Modified Stress Tolerance Index (Msti). Bioscience Biotechnology Research Communications, 13, 2114-2117.
Khayatnezhad, M. & Gholamin, R. 2020b. Study Of Durum Wheat Genotypes' Response To Drought Stress Conditions. Helix, 10, 98-103.
Khayatnezhad, M. & Gholamin, R. 2021a. The Effect Of Drought Stress On The Superoxide Dismutase And Chlorophyll Content In Durum Wheat Genotypes. Advancements In Life Sciences, 8, 119-123.
Khayatnezhad, M. & Gholamin, R. 2021b. Impacts Of Drought Stress On Corn Cultivars (*Zea mays* L.) At The Germination Stage. Bioscience Research, 18, 409-414.
Li, A., Mu, X., Zhao, X., Xu, J., Khayatnezhad, M. & Lalehzari, R. 2021. Developing The Non-Dimensional Framework For Water Distribution Formulation To Evaluate Sprinkler Irrigation. Irrigation And Drainage.
Muhibbu-Din, I. 2020. Investigation Of Ambient Aromatic Volatile Organic Compounds In Mosimi Petroleum Products Depot, Sagamu, Nigeria. Anthropogenic Pollution Journal, 4, 65-78.
Omrani, M. & Fataei, E. 2018. Synthesizing Colloidal Zinc Oxide Nanoparticles For Effective Disinfection; Impact On The Inhibitory Growth Of Pseudomonas Aeruginosa On The Surface Of An Infectious Unit. Polish Journal Of Environmental Studies, 27.
Radmanesh, M. 2021. Evaluation Of The Efficient Management Of Greenhouses For Healthy Items In The Province Of Alborz. Water And Environmental Sustainability, 1, 20-23.
Ren, J. & Khayatnezhad, M. 2021. Evaluating The Stormwater Management Model To Improve Urban Water Allocation System In Drought Conditions. Water Supply.
Rodríguez, R. 2021. The Study Of Enzyme-Water Mutualism Theory. Water And Environmental Sustainability, 1, 44-49.
Si, X., Gao, L., Song, Y., Khayatnezhad, M. & Minaeifar, A. A. 2020. Understanding Population Differentiation Using Geographical, Morphological And Genetic Characterization In *Erodium cicunium*. Indian J. Genet, 80, 459-467.
Sun, Q., Lin, D., Khayatnezhad, M. & Taghavi, M. 2021. Investigation Of Phosphoric Acid Fuel Cell, Linear Fresnel Solar Reflector And Organic Rankine Cycle Polygeneration Energy System In Different Climatic Conditions. Process Safety And Environmental Protection, 147, 993-1008.