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CHALLENGES AND RESEARCH OPPORTUNITIES FOR WHEAT PRODUCTION IN WARM DRYLAND REGIONS OF IRAN

SUMMARY

Sustainable production of wheat is a major consideration in terms of meeting demands for food security in vast dryland regions in Iran affected by specific environmental conditions. Effects on production from adverse environmental conditions can be minimized using stable yield cultivars under optimum management practices to stabilize wheat production in subtropical dryland regions of over than 1.2 million hectares in Iran. During the last two decades, much research has been done by the Dryland Agricultural Research Institute (DARI), this has been effective in maintaining and improving wheat yield, but there are still large gaps between experimental and on farm conditions. Wheat is the dominant cereal crop and continuous wheat cultivation systems are becoming more common. Appropriate technologies such as alternative crops instead of fallow will help in sustainable agricultural production and restrict environmental damage. Conventional breeding with a special focus on adaptation to marginal environments provides a necessary baseline in terms of genetic background into which new traits and their genes can be introduced. However, specific research objectives to identify and accumulate new and more appropriate combinations of stress-adaptive traits must follow a systematic approach and there is still much to learn about how some potentially useful traits (and their genes) interact with each other, with different genetic backgrounds, and across a range of environments including warmer and drier environments (predicted by climate change) in which they must be deployed.

Keywords: Alternative crops, Designing traits, Drought, Heat, Wheat, Yield stability

INTRODUCTION

Despite its declining importance as a contributor to the gross domestic product (GDP), agriculture still represents an important input to the national economy. Agriculture also supports rural livelihoods in Iran. However, successive years of severe drought during 1998–2001 have substantially limited growth in terms of agricultural output. As a result, agriculture's share of the GDP has fallen from one-quarter in the early 1990s to 14 percent in 2005 (Stads et al., 2008). It has been estimated that the drought in 1999-2001 affected some 37

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million people in Iran (over 50 percent of Iran's total population) (Ghaffari, 2010).

Water deficiency is one of the main universal constraints attributing to reduced yield and the problem that is likely to intensify in the future (Slafer et al., 2005). The current global average yield of wheat is approximately 2.5 tons per hectare. By 2020, this yield needs to increase to 4.2, if global demands are to be met. This translates into an annual increase of 85 kilograms per hectare for the next 20 years (Rajaram, 2005).

High temperature and drought stress currently limit wheat productivity in much of the developing and developed world and the impact of predicted climate change will increasingly affect wheat production globally. At least 60 million ha of wheat is grown on marginal dryland in developing countries. National average yields range from 0.8 to 1.5 t/ha, this amounts to approximately 10% to 50% of their theoretical potential under irrigation (Reynolds et al., 2004). Half the area sown to wheat in developing countries, and up to 70% of that grown in developed countries suffers from periodic drought (Trethowan and Pfifer, 1999). Due to climate change, it has been estimated that precipitation will decline by 9 per cent and temperature will increase by 0.5-1.5 ºC in Iran (Sharifi and Bani-Hashemi, 2010).

The total harvested wheat area in Iran is more than 6.7 million hectares from which about 2.6 million hectares (40%) is irrigated and about 4.1 million hectares (60%) is rainfed. The total wheat harvested area in Iran has not changed significantly over the period of 1992-2010; however, it dropped to its lowest level of about 5.0 million hectares in 1998-1999 and 2007-2008 mainly due to severe drought conditions that resulted in a decrease in the area for wheat harvest. The average wheat grain yield peaked to about 2,500 kg per hectare in 2005, but decreased to about 2,150 kg per hectare in 2008 due to drought. The average grain yield of irrigated wheat was 3,800 kg per hectare whereas the average grain yield for wheat was 1,100 kg per hectare under dryland conditions (Jalal Kamali et al., 2012).

Dryland in Iran has three distinct agro-ecological zones: cold, warm and temperate. Warm dryland areas (over 1.2 million hectares) are characterized with a Mediterranean climate and as such there is a winter rainfall pattern, mild winters and warm to hot summer temperatures. Khouzestan, Boushehre, Golestan and some parts of Kermanshah, Ilam, Lorstan, Kogilouieh & Boyrahmad and Fars provinces are located in this type of region (Table 1). The main cultivated area is devoted to wheat in rotation with fallow or more recently with lentil and canola (Mohammadi and Karimizadeh, 2012).

This paper does not aim to cover an exhaustive review of the literature that has contributed to the management of the dryland wheat cultivation in warm dryland areas, but is an attempt to cover the following points: (1) The differences between actual and realized wheat yields and some factors related to the development of management practices for wheat cultivation systems; and (2)

Some issues that will need to be modified in the farming systems of dryland areas and modifications that should be considered in physio-breeding programs.

Table 1. Cultivated wheat land (000ha) and important characteristics in different dry land zones in Iran

Zone	Area	Definition
Cold	2610 (60%)	-Cold to very cold temperatures, Low to moderate rainfall, more than 1000 masl -Average absolute min. temp. is –14ºC, about 3 months freezing days - Winter and/or cold tolerant and facultative wheat -Hamedan, Ardabil, East and West Azarbaijan, Zanjan, Qazvin and some parts of Khorasan and Fars provinces
Temperate	452 (10%)	-Temperate temperatures, Moderate rainfall, about 1000 masl, -Average absolute temp. is –10ºC, about 50 freezing days . facultative wheat some parts of Lorestan, Ilam and Kermanshah provinces
Warm	1275 (30%)	-Warm temperatures, Moderate rainfall to Low rainfall, less than 800 masl, -Average absolute min. temp. is –5ºC, less than 30 freezing days. -Spring wheat -Khouzestan, Boushehre,, and some parts of Kohgilouieh, Lorstan, Ilam, Ardabil and Fars Provinces

Source: Jalal Kamali et al. (2012) and Esmaeilzadeh Moghaddam et al. (2009).

Main barriers of optimum improvement performance

Dryland areas play an important role in Iran's economy and have great potential to facilitate increased agricultural production. Suitable genotypes can be recommended for cultivation in drought prone areas of Iran under various climatic conditions in semi-warm regions.

In recent years, research by the Dryland Agricultural Research Institute (DARI) has identified several wheat cultivars recommended for cultivation in subtropical dryland areas. However, they have not reached expected performance levels. The average yield of the Zagros cultivar during ten years (1990-2000) under experimental conditions at the Gachsaran agricultural research station was equivalent to 3787 kg per hectare. While, the average production in farm conditions in subtropical areas of Kohgilouyeh and Boyrahmad province for the same period was estimated at 1101 kg per ha. In other words, a big gap existed between achievable performance and realized yield in farm conditions (Mohammadi, 2006).

Part of this difference contributed to the superior performance of improved cultivars to that of landraces used by some farmers. While, comparing the average production of landrace cultivars in a stationary environment and farm conditions, significant difference was observed. The ten-year average yield of local wheat in stationary conditions represented a 1359 kg/ha increment compared to other farming areas for the same period. Obviously, part of this difference was related to environmental factors, but the use of transfer technologies also needs to be presented. Firstly, research stations are usually located in relatively fertile areas. Moreover, availability of adequate facilities and funds, daily visits and particularly, small experimental plots also partly justified this difference. The second difference related to the productive potential and actual performance of farms. This different set of constraints resulting from social, economic, technical and biological aspects that can fit with such a good relationship between research and extension sectors for appropriate transfer of technology to farmers, will to some extent be compensated for. Biological limitations include type of variety, weeds, pests, diseases and soil conditions. Social constraints – economic involvement of organizations for costs and benefits, credit, traditions and attitudes, technical knowledge and amounts of available inputs.

The use of new seed varieties has been implemented faster than other technologies, due to the low cost of this technology. It should be considered that in a comprehensive plan as recommended by researchers, seed has an important role, but, its value is only achievable within an integrated plan. The slow development of new and improved varieties may be due to the need to apply agro-techniques. Use of improved cultivars can only be beneficial under application of improved agronomic operations.

In a poor agronomic management system, without suitable machinery and the conversion of rangeland to dryland farming in some areas, when plants are not provided with enough nutritional elements, organic matter is low, bed preparation is not done well, weeds, pests and diseases are not controlled and the other cultivation techniques are not properly applied, it cannot be expected that improved cultivars can necessarily perform better than landraces.

It should not be forgotten that cultivated plants differ not only in their inherent capacity but also in their abilities to compete with other plants. In the absence of weed control, landraces with rapid growth and good shading are superior competitors compared to improved cultivars (Hansen 1998).

Although the use of all available capacity is not possible or expected, the application of modern management techniques such as crop rotation with improved cultivars can be a key factor to increase water use efficiency in dryland areas, which greatly benefits farmers.

Crop rotation is one principle that could facilitate the long-term viability of dryland farming systems. It is practiced to control diseases, weeds and insects, to improve soil fertility (mainly from the inclusion of legumes with fix nitrogen), to spread the risk of crop failure and to stabilize income. Cereal-fallow and somewhat cereal-chick pea-fallow (Lorestan province), rotations are common to most parts of subtropical dryland areas.

In recent years, successive planting of wheat has been accepted. This field is not based on agronomic principles and documentation, but is affected by economic and managerial factors such as shortage of cropping land, improved mechanization, increasing unemployment forces, availability of fertilizers and government subsidies (Mohammadi and Ghaffari, 2009). Successive cropping in soil with low fertility and organic matter and a generally low input environment is generally conducive to low productivity (Raimbault and Vyn, 1991).

It seems that lentil (Lens culinaris) and colza (Brassica napus) are capable of producing economical and durable productivity within existing cropping systems under dryland conditions. These plants are competitive with wheat in terms of marketability; they have also low risk, relative to pricing policies of the government and the community's needs.

Lentil: Lentil is grown on about 205,000 hectares in Iran, but with poor productivity of 464 kg/ha. Farmers grow winter lentil on about 10,000 hectares (Sarker et al., 2002). By planting lentil when soil moisture is plentiful, farmers can enjoy a boost in yield and profit. This begs the question that if the winter crop is so profitable then why have farmers not tried to grow lentil? Experience has demonstrated that five prerequisites for successful lentil production are as follows: (1) weed control, (2) larger seed size, (3) resistance to fusarium wilt and ascochyta blight, fungal diseases, (4) method of harvesting, and (5) improvement of seed quality.

Farmers can counteract these problems with an integrated weed control program using appropriate herbicide and mechanical control. Smallholder farmers can use hand weeding. Farmers can counter ascochyta blight by growing resistant cultivars, and by including them as part of an integrated disease management strategy (Sarker et al., 2002).

Major lentil growing areas in Iran (93%) are in dryland conditions (Sabaghpour, 2007). Since lentil is a rain fed crop, yield stability is an important objective in most breeding program (Mohebodini, 2012) and it is important to find genotypes that are high yielding and adapted to different dryland conditions. Local landraces have low yield potential and are vulnerable to a range of biotic and abiotic stresses. To date, the only cultivar released in Iran for early-spring sowing is Garcharan (ILL 6212). Farmers favor this variety because of its higher yield and larger seed size.

Increased wheat yields following grain legumes have been associated with residual nitrogen from a previous crop (Asseng et al., 1998), and the role of legumes in farming systems of the Mediterranean area have been extensively reviewed (Osman et al., 1990). Spread of lentil cultivation with appropriate varieties and production technologies will improve farmers' incomes in the region.

Colza: Presently, over 85-90% of the vegetable oil consumed in Iran has been imported from abroad (Pourdad and Beg, 2007). The main reason for this high level of import is that there is only a small area under oilseed cultivation in the country. Rapeseed had not been grown in the country (Unknown, 2001). But, due to supportive government policies, research and extension activities, rapeseed cultivation in 2007 reached about 169 thousand hectares, of which 46.9

percent was devoted to the cultivation in dryland conditions with an average yield of 1907 kg ha in different agro-ecological zones (Unknown, 2007).

The possibility of increasing the area under oil seed crops in irrigated conditions is limited due to scarcity of water. However, in dryland regions a very large cultivated area is kept fallow, therefore there is considerable potential to increase the area under rapeseed cultivation if suitable crop varieties and production technology is developed for the target regions. Reproductive growth of rapeseed is exposed to low rainfall and high temperature in this region. However, rapeseed has shown highly superior performance in view of seed yield and oil content compared to other alternative oilseed crops such as sunflower and safflower. To date, two hybrids Hyloa 401 and Hyola 308 showed the best performances in warm dryland regions with good stability in diverse environments.

Optimal rapeseed seed yield should be accompanied by proper agro-techniques. Research on the identification of suitable rapeseed varieties and development of production practices to realize economical yield of rapeseed have been underway at Dryland Research Institute stations particularly, in warmer regions.

On current evidence, it is difficult to envisage a sustainable system that does not include some aspect of crop rotation or some other flexible cropping sequence that contributes to disease, weed and pest management, soil fertility and income stability. Such a system could also incorporate soil renovation, retention of crop residues and reduced or zero-tillage (Curtis et al., 2002).

Current breeding activities and prospects of future plans

The optimum variety should have superiority in environments with different stress intensities. Some genotypes are only favorable in one specific environment, like landraces that have been adapted for severe local stresses or bred cultivars that have been genetically modified for high yield in full irrigation conditions. The introduction of improved varieties is one of the most powerful and cost-efficient means of enhancing crop productivity and farmer’s income. Plant performance in diverse environments depends on the efficiency of developed varieties, which should be matched to a specific production area (Mohammadi et al., 2011; Sabaghnia et al., 2012).

Many regions need to cultivate wheat cultivars that are capable of high yields when the weather is beneficial and that will produce stable yields when conditions are adverse. These genotypes should have high yield potential in both favorable and high temperature environments (Yang et al., 2002).

Up to 1990, wheat cultivars grown in the warm dryland areas of Iran were mainly native populations such as; Seiah ryshak, Shahyvndy, Ghareh-Sonbol, Sareh Bughda, Sorkh Turkman, Orooji or a mixture of different wheat varieties known Chahar Tokhm as well as varieties imported from neighboring countries such as Sholeh from Iraq. Since then, national wheat programs in close collaboration with International Research Centers as CIMMYT and ICARDA have led to release some improved wheat cultivars (Table 2).

Table 2. Agronomic characteristics of wheat cultivars released for warm dryland areas of Iran, 1993-2011

Cultivar	Origin	Year of release	Plant height (cm)	Days to maturity (day)	Thousand kernel weight (gram)	Grain yield (kg/ha)
Maroon	Iran	1993	80-105	130-135	37	3300
Zagros	CIMMYT	1997	77-100	134-139	36	3450
Niknejad	CIMMYT	1997	75-105	137-145	34	3500
Gahar	CIMMYT	1997	73-95	139-150	31	3850
Seimareh	ICARDA	1997	77-100	137-140	36	3350
Kouhdasht	CIMMYT	2001	90-95	133-138	37	3500
Dehdasht	ICARDA	2008	75-95	135-138	39	3700
Karim	ICARDA	2011	75-90	130-135	39	3700

Source: Mohammadi and Karimizadeh (2012).

A newly released cultivar for subtropical dryland regions of Iran showed on average 338 kg/ha (13.7%) yield preference compared to the check (Kouhdasht) during the years 2004-2009 across all warm research stations. In view of different stability parameters, the line had the best rank with the least standard deviation and small coefficient of variation. It showed a considerable level of resistance against important current diseases such as yellow rust, brown rust, common bunt, dwarf bunt and powdery mildew. It also had good preference for qualitative characteristics in addition to earliness, optimum plant height and increased thousand-kernel weight compared to the check. Overall, due to yield stability, optimum grain yield and important agronomic traits and qualitative characteristics, this genotype was introduced through the Agricultural Research, Education and Extension Organization under name of “Karim” in 2011 (Mohammadi et al., 2012).

The spread of modern cultivars for use in drier areas has been much slower, and their impact on yields far weaker than in favorable areas (Evans 1998). Wheat yield gains over traditional cultivars have usually been below 20 %, and often less than 10 %, and have even been negligible in extremely harsh environments. Nevertheless, considerable improvement in the adaptation of wheat to dry areas has been made by plant breeders over the last 50 years. The adoption of modern varieties, however, has lagged behind in irrigated areas and the percentage yield advance has been considerably lower (Trethowan and Pfifer, 1999).

The annual gain in genetic yield potential in drought environments is only about half (0.3-0.5%) of that obtained in irrigated optimum conditions. Many investigators have attempted to produce wheat adapted to semiarid environments but with limited success. The CIMMYT wheat program follows a system of breeding for drought tolerance in which yield responsiveness is combined with adaptation to drought conditions. Because most semiarid environments differ significantly in terms of their annual precipitation distribution and because water availability also differs across years in these environments, it is prudent to construct a genetic system in which plant responsiveness provides a bonus whenever higher rainfall improves a production environment (Timothy et al., 2005).

A large body of recent work has demonstrated that new opportunities exist to improve the adaptation of wheat to heat and drought stressed environments (Trethowan and Mujeeb-Kazi 2008; Rebetzke et al. 2009; Reynolds et al. 2010). Recent emphasis on breeding for marginal environments has increased the focus on dry environments, and a multidisciplinary effort (CIMMYT and ICARDA, 2010). The main inputs from a physiological point of view will include the following points:

-To identify and characterize wheat regions taking into account future climatic scenarios.
-To design physiological trait combinations to address heat and drought-stress targets based on a range of unpredictable environments where rainfall and temperature vary significantly within and between seasons.
-To identify sources of those traits among current breeder materials and germplasm bank accessions including landraces, wild relatives, landraces, and other genetic resources.
-To evaluate genetic gains associated with specific traits or trait combinations when introgressed into different adapted backgrounds.
-To pre-screen diploid and tetraploid genotypes for use in development of synthetic wheat lines to increase the probability of expression of favorable traits being in hexaploid and tetraploid combinations.
-To generate new genetic materials based on combining useful expression of physiological traits with additive gene action and no significant yield penalties in favorable years.

REFERENCES

Asseng, S., Fillery, I.R.P. & Gregory. P.J. (1998): Wheat response to alternative crops on a duplex soil. Australian Journal of Experimental Agriculture, 38: 481-488.

CIMMYT and ICARDA. (2010): WHEAT — Global Alliance for Improving Food Security and the Livelihoods of the Resource-poor in the Developing World. Proposal submitted by CIMMYT and ICARDA to the CGIAR Consortium Board. CIMMYT. pp. 166.

Curtis, B.C., S. Rajaram, Gomez. M. (2002): Bread wheat: improvement and production. FAO. pp. 554.

Esmaeilzadeh Moghaddam, M., Jalal Kamali M.R., Aghaee M., Afshari F. & Roustaii, M. (2009): Status of wheat and wheat rusts in Iran. Pp. 155-158. In:

R.A. McIntosh, (ed.). Proceedings: Oral Papers and Posters. 2009. BGRI Technical Workshop, Obregon, Mexico. March 17-20.

Evans, L.T. (1998): Feeding the ten billion: plants and population growth Cambridge: Cambridge University Press.

Ghaffari, A. (2010): The role of Dryland Agricultural Research Institute in drought mitigation in Iran. Options Méditerranéennes, A no. 95, 273-278.

Hansen, P.K. (1998): Competitive ability of different winter wheat varieties. EWRS workshop crop- weed interaction. Dijon.France.

Jalal Kamali, M.R., Esmaeilzadeh Moghaddam M., Roustaii M. & Afshari F. (2012):. An Overview on Wheat Status in Iran. Pp. 374-381. In: Singh, S.S., Hanchinalm R.R., Singh G., Sharma R.K., Tyagi B.S., Saharan M.S., Sharma I. (Eds.). Wheat: Productivity Enhancement under Changing Climate. Narosa Publishing House. New Delhi, Chennai, Mumbi, Kolkata.

Mohammadi M.. (2006): Limiting factors for cereal yield in subtropical dryland (case study in Kogilouieh & boyrahmad province): In: Ninth Iranian crop science congress. Aug.27-29. 2009.Aboureihane campus. University of Tehran. Iran. (In Persian).

Mohammadi, M., & A.A. Ghaffari. 2009(): Important options in crop rotation for dryland condition (I. Fallow and continuous cultivation). Zeitoon. 201:5-8.

Mohammadi M., Karimizadeh R., & Abdipour M., (2011): Evaluation of drought tolerance in bread wheat genotypes under dryland and supplemental irrigation conditions. Australian Journal of Crop Science. 5(4):487-493.

Mohammadi, M., Kalateh, M., Hosseinpour, T., Hassanpour Hosni, M., Roustaii, M., Khanzadeh, H., Karimizadeh, R., Khalilzadeh, G., Poursiabidi, M.M., Armion, M., Ghojogh, H., Falahi, H.A., Haghparast, R., Rajabi, R., Abdollahi, A., Daryaii, A., Ahmadi, M.M., Mardoukhi, V., Dehghan, M.A., Houshiar R.& Afshari, F. (2012): Karim, A New Bread Wheat Cultivar for Semitropical Dryland Conditions. Seed and Plant production Journal 27 (4): 95-98.

Mohammadi, M. & Karimizadeh R. (2012): Insight into heat tolerance and grain yield improvement in wheat in warm rainfed regions f Iran. Crop Breeding Journal 1(2): 56-62.

Mohebodini M., Karimizadeh R., Mohammadi, M.& Sabaghnia, N. (2012): Principal coordinates analysis of genotype environment interaction in grain yield of lentil genotypes. Agriculture & Forestry, Vol. 57. (11) 3: 93-107.

Osman, A.E., Ibrahim, M.H. & Jones M.A. (1990): The Role of legumes in the farming systems of the Mediterranean areas. Dordrecht, Netherlands, Kluwer Academic Publishers. 310 pp.

Pourdad, S.S. & A. Beg, (2007): Performance of spring type canola (Brassica napus L.) in semi cold Midwest region of Iran. Proceeding of 12th international rapeseed congress. Vol III Mar 26-30. Wuhan, China. pp 91-93.

Raimbault, B.A. & Vyn. T.J. (1991): Crop rotation and tillage effects on corn growth and soil structure stability. Agronomy Journal (83): 979-985.

Rajaram, S. (2005): Role of conventional plant breeding and biotechnology in future wheat production. Turkish Journal of Agriculture and Forestry.29: 105-111.

Rebetzke, G.J., Chapman S.C., McIntyre, L., Richards, R.A., Condon, A.G., Watt, M., Van Herwaarden. A. (2009): Grain yield improvement in water-limited environments. In: Carve, B.F. (ed.), Wheat: Science and Trade. Ames, Iowa, US, Wiley-Blackwell, 215–249.

Reynolds, C.R.P., D. Hays, S. Chapman, (2010): Breeding for adaptation to heat and drought stress. In: Reynolds, C.R.P., Climate Change and Crop Production, CABI, London, UK.

Reynolds, M., B. Skovmand, R. Trethowan, W. Pfeiffer. (2004):. Evaluating conceptual model for drought tolerance. CIMMYT. Mexico. WWW. CIMMYT.ORG.

Sabaghnia, N., Mohammadi, M. & Karimizadeh R.(2012): The evaluation of genotype × environment interactions of durum wheat's yield using of the AMMI model. Agriculture & Forestry, 55(09) (1-4): 5-21.

Sabaghpour, S.H. (2007): Stability analysis of grain yield for promising lentil lines in autumn planting under dryland conditions. Iranian Journal of Crop Science. 8 (4): 312-322.

Sarker, A., Aydin, N. Aydogan, A., Sabaghpoue, S.H., Ketata, H., Kusmenoglu, I. & Erskine. W. (2002): Winter lentil promise improved nutrition and income in west Asian highlands ICARDA. Caravan No. 16:14-16.

Sharifi, F. & Bani-Hashemi. S.A. (2010): Assessment of climate change and its consequent mpacts in Iran. Climate Change Meeting. Academy of Science of Iran. (In Persian).

Slafer, G.A., Araus, J.L., Royo, C. & Morol, L.G. (2005): Promising ecophysiological traits for genetic improvement of cereal yields in Mediterranean environments. Annals of Biology.146:61-70.

Stads, G.J., Roozitalab, M.H., Beintema, N.M. & Aghajani, M. (2008): Agricultural research in Iran, policy, investments and institutional profile. International Food Policy Research Institute. pp.58.

Timothy, G., Rajaram, S., Ginkel, M.V., Trethowan, R., Braun, H.J. & Cassaday, K. (2005): New wheats, for a secure. Sustainble future. http:/ /www.CIMMYT.org /dryland programe / Publication.

Trethowan, R.M. & Mujeeb-Kazi, A. (2008): Novel germplasm resources for improving environmental stress tolerance of hexaploid wheat. Crop Sci. 48, 1255-1265.

Trethowan, R. & Pfieffer, W. (1999): Challenges and future strategies in breeding wheat for¬¬ adaptation to drought stress environments. http://www.cimmyt. org/english/ docs/ proceedings/…/pdfs/ challenges.pdf.

Unknown, (2001): Summary and achievements and research and training program. In: Proceeding of Eighteen planning and coordination meeting. Maragheh. Iran. 9-11 Sep. 2000.

Unknown, 2007(): Agricultural statistic in 2006-5007. Jihade-Agriculture ministry publication: (1).p. 60.

Yang, J., Sears, R.G., Gill, B.S. & Paulsen, G.M. (2002): Genotypic differences in utilization of assimilate sources during maturation of wheat under chronic heat and heat shock stresses. Euphytica. 125: 179–188.

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IZAZOVI I MOGUĆNOSTI ISTRAŽIVANJA U PROIZVODNJI PŠENICE U TOPLIM I SUŠNIM OBLASTIMA IRANA

SAŽETAK

Održiva proizvodnja pšenice je od suštinske važnosti u pogledu zadovoljavanja potreba za obezbjeđivanjem hrane u ogromnim sušnim regionima Irana, koji su pod uticajem specifičnih uslova životne sredine. Uticaji nepovoljnih uslova na proizvodnju se mogu umanjiti korišćenjem kultivara koji daju stabilni prinos pri optimalnom održavanju, čime bi se stabilizovala proizvodnja u suptropskim sušnim predjelima kakvih je više od 1.2 miliona hektara u Iranu. Tokom zadnje dvije decenije, mnoga istraživanja su obavljena od strane Poljoprivrednog instituta za istraživanje sušnog zemljišta (DARI), koja su bila efikasna u održavanju i poboljšanju prinosa pšenice, ali i dalje postoji veliki jaz između eksperimentalnih uslova i onih koji su prisutni na usjevima. Pšenica predstavlja dominantnu žitaricu i sistemi za njeno kontinuirano gajenje se sreću sve češće. Adekvatne tehnologije, poput zamjenjivanja ugra alternativnim kulturama, će pomoći u održivoj poljoprivrednoj proizvodnji i suzbiti nepovoljne uticaje okruženja. Konvencionalno uzgajanje, sa specijalnim akcentom na adaptaciju na marginalne sredine, pruža neophodnu osnovu u pogledu genetske podloge u koju se mogu ugraditi nove karakteristike i njihovi geni. Međutim, specifični ciljevi istraživanja - da se pronađu i sakupe novije i podesnije kombinacije karakteristika prilagodljivih na stres, moraju pratiti sistematski pristup, a neophodno je još dosta toga saznati o tome kako neke potencijalno korisne karakteristike (i njihovi geni) reaguju međusobno, sa različitim genetskim podlogama, kao i u nizu različitih sredina, uključujući toplije i sušnije sredine (predviđene klimatskim promjenama), u kojima bi se morale razviti.

Ključne riječi: alternativne kulture, oblikovanje karakteristika, suša, vrućina, pšenica, stabilnost prinosa