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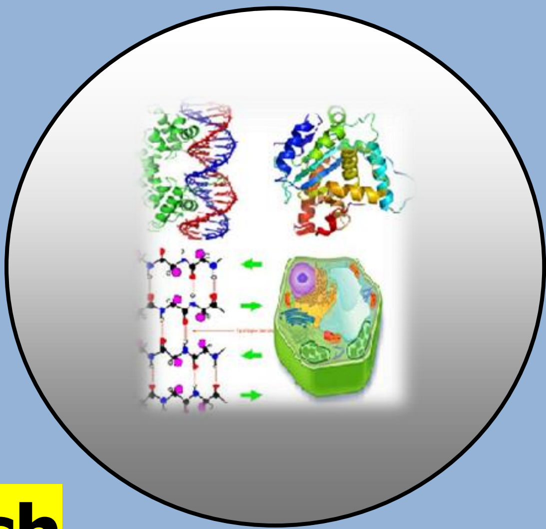
By

Hamid Kheyrodin

ISSN 0970-4973 Print
ISSN 2319-3077 Online/Electronic

Global Impact factor of Journal: 0.756
Scientific Journals Impact Factor: 3.285
Index Copernicus International Value
IC Value of Journal 6.01 Poland, Europe

J. Biol. Chem. Research
Volume 32 (2) 2015 Pages No. 650-656



Journal of Biological and Chemical Research

An International Peer reviewed Journal of Life Sciences and Chemistry

Indexed Abstracted and Cited in about 25 different Scientific Databases around the World

Published by Society for Advancement of Sciences®

J. Biol. Chem. Research. Vol. 32, No. 2: 650-656, 2015
(An International Peer reviewed Journal of Life Sciences and Chemistry)
Ms 32/2/150/2015

ISSN 0970-4973 (Print)
ISSN 2319-3077 (Online/Electronic)

Dr. Hamid Kheyrodin
http:// www.sasjournals.com
http:// www.jbcr.in
jbiolchemres@gmail.com
info@jbcr.in

RESEARCH PAPER

Received: 27/04/2015 Revised: 18/07/2015 Accepted: 20/07/2015

Effect of Foliar Spray of Microelement, Zn, Fe and Mn on the yield of Drought Stressed Wheat Crop

Hamid Kheyrodin
Faculty of Desert Science, Semnan University, Semnan, Iran

Wheat is one of the most important crop in the term of food production. During present investigation I study the effect of water stress and foliar microelement Zn, Fe and Mn on the performance and production of wheat. Field trials were conducted on randomized complete block with 3 replications in water stressed crop.
The results showed that water deficit stress reduced plant height, number of grains per plant, cob weight, ear weight (with grain), 100 grains weight, economic yield, biological yield and harvest index. The plant height respectively. The interaction of water deficit stress and foliar spraying of Fe and Mn with combination of irrigation the maximum economic yield and biological yield were obtained.
Key Words: Water Deficit Stress, Spray, Zn, Fe, Mn and Yield.

INTRODUCTION

The cultivation of wheat (*Triticum* spp.) reaches far back into history. Wheat was one of the first domesticated food crops and for 8 000 years has been the basic staple food of the major civilizations of Europe, West Asia and North Africa. Today, wheat is grown on more land area than any other commercial crop and continues to be the most important food grain source for humans. Its production leads all crops, including rice, maize and potatoes.

Although the crop is most successful between the latitudes of 30° and 60°N and 27° and 40°S (Nuttonson, 1955), wheat can be grown beyond these limits, from within the Arctic Circle to higher elevations near the equator. Development research by the International Maize and Wheat Improvement Center (CIMMYT) during the past two decades (Saunders and Hettel, 1994) has shown that wheat production in much warmer areas is technologically feasible. In altitude, the crop is grown from sea level to more than 3 000 masl, and it has been reported at 4 570 masl in Tibet (Percival, 1921). The optimum growing temperature is about 25°C, with minimum and maximum growth temperatures of 3° to 4°C and 30° to 32°C, respectively (Briggle, 1980). Wheat is adapted to a broad range of moisture conditions from xerophytic to littoral. Although about three-fourths of the land area where wheat is grown receives an average of between 375 and 875 mm of annual precipitation, it can be grown in most locations where precipitation ranges from 250 to 1 750 mm (Leonard and Martin, 1963). Optimal production requires an adequate source of moisture availability during the growing season; however, too much precipitation can lead to yield losses from disease and root problems. Cultivars of widely differing pedigree are grown under varied conditions of soil and climate and show wide trait variations. Although wheat is being harvested somewhere in the world in any given month, harvest in the temperate zones occurs between April and September in the Northern Hemisphere and between October and January in the Southern Hemisphere (Percival, 1921). Classification into spring or winter wheat is common and traditionally refers to the season during which the crop is grown. For winter wheat, heading is delayed until the plant experiences a period of cold winter temperatures (0° to 5°C). It is planted in the autumn to germinate and develop into young plants that remain in the vegetative phase during the winter and resume growth in early spring. This provides the advantage of using autumn moisture for germination and making effective use of early spring sunshine, warmth and rainfall. Spring wheat, as the name implies, is usually planted in the spring and matures in late summer but can be sown in autumn in countries that experience mild winters, such as in South Asia, North Africa, the Middle East and the lower latitudes. Wheat is special in several ways. Wheat is grown on more than 240 million ha, larger than for any other crop, and world trade is greater than for all other crops combined. The raised bread loaf is possible because the wheat kernel contains gluten, an elastic form of protein that traps minute bubbles of carbon dioxide when fermentation occurs in leavened dough, causing the dough to rise (Hanson *et al*., 1982). It is the best of the cereal foods and provides more nourishment for humans than any other food source.

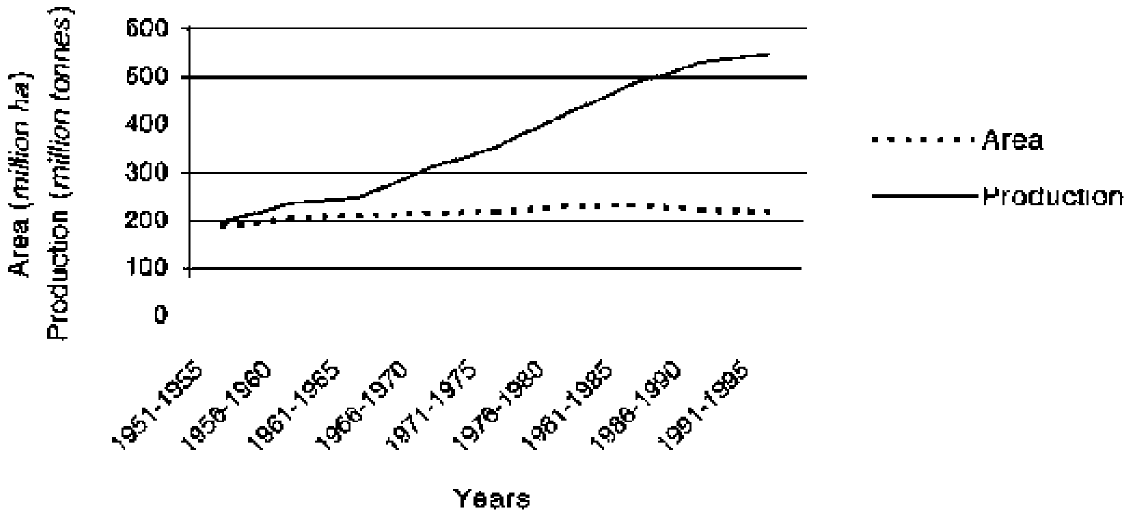


Figure 1. Worldwide wheat area and production.

Wheat is a major diet component because of the wheat plant's agronomic adaptability, ease of grain storage and ease of converting grain into flour for making edible, palatable, interesting and satisfying foods. Doughs produced from bread wheat flour differ from those made from other cereals in their unique viscoelastic properties (Orth and Shellenberger, 1988). Wheat is the most important source of carbohydrate in a majority of countries. Wheat starch is easily digested, as is most wheat protein. Wheat contains minerals, vitamins and fats (lipids), and with a small amount of animal or legume protein added is highly nutritious. A predominately wheat-based diet is higher in fiber than a meat-based diet (Johnson *et al*., 1978). Wheat is also a popular source of animal feed, particularly in years where harvests are adversely affected by rain and significant quantities of the grain are made unsuitable for food use. Such low-grade grain is often used by industry to make adhesives, paper additives, several other products and even in the production of alcohol.

Production and Trade

World wheat production increased dramatically during the period 1951-1990, although the expansion of the area sown to wheat has long ceased to be a major source of increased wheat output (CIMMYT, 1996) (Figure 1.1). Production reached an all time high of 592 million tons in 1990 and has been 500 million tones or above since 1986 when 529 million tones was produced. Since 1990, production has remained relatively constant. The share of wheat output from high-income countries has fallen from about 45 percent in the early 1950s to about 35 percent in recent years. Policy changes toward crop reserve programmes to preserve soils have taken considerable production area from wheat in high-income countries. In the past five years, developing countries have produced more than 45 percent of the world's wheat.

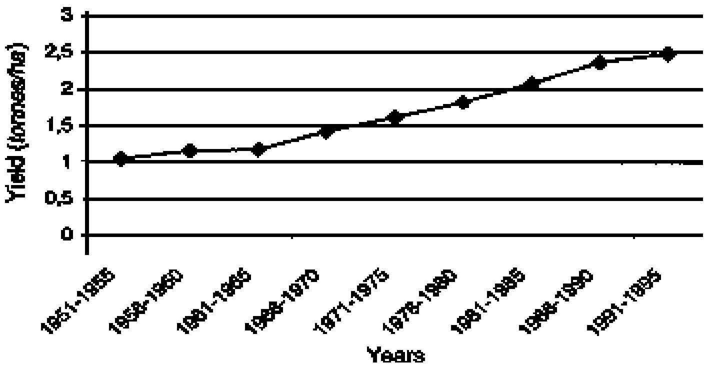


Figure 2. Wheat yields worldwide, 1951-1995.

Most of the increase in world wheat production resulted from greater yield per hectare (Figure 1.2). In 1951, world production was nearly 1 tone/ha. It reached 2 tones/ha by the early 1980s and climbed to nearly 2.5 tones/ha by 1995. Yields have *World Bread Wheat: improvement and production* continued to climb with little suggestion of a trend reduction. Both genetically improved cultivars for yield and better cultural methods have contributed to the yield increases, but it is difficult to quantify the effects of each. Yield stability has increased substantially across environments largely due to the adoption of management-responsive, high-yielding, disease-resistant semi dwarf wheat cultivars (usually referred as HYVs) throughout much of the world, particularly in developing countries. Improved agronomic practices also played an important role in enhancing the dependability and sustainability of yields.

In Turkey, for example, production nearly doubled from 9 to about 17.5 million tons between 1971 and 1982. This impressive increase resulted primarily from the use of water-conserving cultural practices on the Anatolian Plateau (Curtis, 1982; Dalrymple, 1986). The use of production inputs, primarily nitrogen fertilizer and irrigation water, has risen dramatically. India and China are two major wheat-producing countries where these inputs have dramatically increased. In China, the yield of all cereals increased from 1.4 to 4.6 tones/ha from 1961 through 1995, and during the same period, yields in India doubled from 1.0 to 2.1 tones/ha (Borlaug and Dowswell, 1996; CIMMYT, 1996).

Wheat genetics

Wheat genetics is more complicated than that of most other domesticated species. Some wheat species are diploid, with two sets of chromosomes, but many are stable polyploids, with four sets of chromosomes (tetraploid) or six (hexaploid).

- Einkorn wheat (*T. monococcum*) is diploid (AA, two complements of seven chromosomes, 2n=14).
- Most tetraploid wheat's (e.g. emmer and durum wheat) are derived from wild emmer, *T. dicoccoides*. Wild emmer is itself the result of hybridization between two diploid wild grasses, *T. urartu* and a wild goat grass such as *Aegilops searsii* or *Ae. speltoides*. The unknown grass has never been identified among now surviving wild grasses, but the closest living relative is *Aegilops speltoides*. The hybridization that formed wild emmer (AABB) occurred in the wild, long before domestication, and was driven by natural selection.
- Hexaploid wheat evolved in farmers' fields. Either domesticated emmer or durum wheat hybridized with yet another wild diploid grass (*Aegilops tauschii*) to make the hexaploid wheat, spelt wheat and bread wheat. These have *three* sets of paired chromosomes, three times as many as in diploid wheat.

The presence of certain versions of wheat genes has been important for crop yields. Apart from mutant versions of genes selected in antiquity during domestication, there has been more recent deliberate selection of alleles that affect growth characteristics. Genes for the 'dwarfing' trait, first used by Japanese wheat breeders to produce short-stalked wheat, have had a huge effect on wheat yields world-wide, and were major factors in the success of the Green Revolution in Mexico and Asia, an initiative led by Norman Borlaug. Dwarfing genes enable the carbon that is fixed in the plant during photosynthesis to be diverted towards seed production, and they also help prevent the problem of lodging. 'Lodging' occurs when an ear stalk falls over in the wind and rots on the ground, and heavy nitrogenous fertilization of wheat makes the grass grow taller and become more susceptible to this problem. By 1997, 81% of the developing world's wheat area was planted to semi-dwarf wheat's, giving both increased yields and better response to nitrogenous fertilizer

Wheat utilization

World wheat utilization or consumption, defined as food, feed, seed and processed uses, as well as waste, has remained near 550 million tons since 1990. Consumption worldwide has increased rapidly since the early 1960s. Wheat consumption in developing countries rose 35 percent during the period 1963-1976. This primarily resulted from increased urbanization and an associated shift in tastes and preferences to wheat over rice and coarse grains, such as maize and sorghum. Also important was the increased adoption of wheat as a food in countries that had consumed little wheat in the past.

The influence of urbanization on wheat consumption was most clearly seen in sub-Saharan Africa where per caput consumption growth rates in the late 1970s and early 1980s exceeded 6 percent annually. Annual consumption growth rates in those areas have now decelerated to near zero or less, while average per caput consumption remains near 10 kg/year. Urban consumers tend to prefer convenience-type foods that require little or no preparation (Curtis, 1982). From the mid-1980s to the present, the annual growth of wheat consumption in all developing countries has decelerated from about 5 percent to less than 2 percent. In high-income countries with mature food wheat markets, changes in consumption take place slowly over time and are driven by population growth and changing dietary preferences (CIMMYT, 1996).

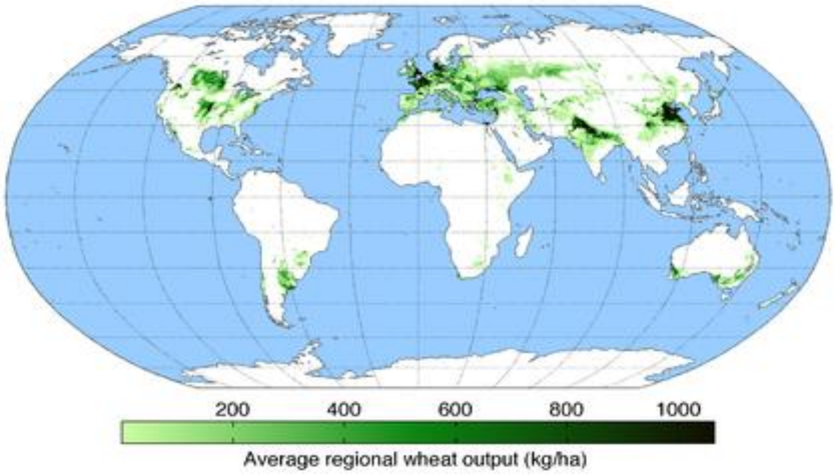


Figure 3. A map of Worldwide wheat production.

Methods

To studies the effects of water stress and foliar microelement Zn, Fe and Mn on the performance of wheat. Field trial in the chorus split tasks based on a randomized complete block with 3 replications. Sub factor spray at four levels and three levels of water stress was the main factor

RESULTS AND DISCUSSION

These serve as the basis for determining critical values of trace elements, especially of cadmium, in soil, corresponding to the allowable maximum level.

In wheat soil analysis, soil sodicity refers the soil's content of sodium compared to its content of other cations, such as calcium. In high levels, sodium ions break apart clay platelets and cause swelling and dispersion in soil. This results in reduced soil sustainability. If the concentration occurs repeatedly, the soil will become cement-like, with little or no structure. Extended exposure to high sodium levels results in a decrease in the amount of water retained and able to flow through soil, as well as a decrease in decomposition rates (this will leave the soil infertile and prohibit any future growth). This issue is prominent in Australia, where 1/3 of the land is affected by high levels of salt. It is a natural occurrence, but farming practices such as overgrazing and cultivation have contributed to the rise of it. The options for managing sodic soils are very limited; one must either change the plants or change the soil. The latter is the more difficult process. If changing the soil, one will need to add calcium to the soil to absorb the excess sodium blocking water flow.

Soil salinity is the concentration of salt within the soil profile or on the soil surface. Excessive salt directly affects the composition of plants and animals due to varying salt tolerance – along with various physical and chemical changes to the soil, including structural decline and, in the extreme, denudation, exposure to soil erosion, and export of salts to waterways. At low soil salinity, there is a lot of microbial activity, that results in an increase in soil respiration, which increases the carbon dioxide levels in the soil, producing a healthier environment for plants.

Wheat Production in Future

In 2013, world production of wheat was 713 million tons, making it the third most-produced cereal after maize (1,016 million tons) and rice (745 million tons).[Wheat was the second most-produced cereal in 2009; world production in that year was 682 million tons, after maize (817 million tons), and with rice as a close third (679 million tons).

The world population growth rate from 1993 to 2000 is estimated at 1.5 percent, while the growth rate of wheat production from 1985 to 1995 was 0.9 percent (CIMMYT, 1996). If population growth continues to double the growth of wheat production, there will likely be serious difficulties in maintaining a wheat food supply for future generations. World population was projected to be 5.8 billion people at the end of 1997 and is expected to reach 7.9 billion by the year 2025, or roughly a 35 percent increase (United States Census Bureau, 1998). In simplistic terms and assuming little or no change in world per caput consumption of wheat, a projection of 786 million tons of wheat will be required annually for human use in the year 2025, an annual production increase of 204 million tons above production in 1997. This underscores the need to rapidly and continuously increase production. Greater wheat production can be achieved in two ways: (i) by expanding the wheat area; and (ii) by improving the yield per unit area sown. In addition, reducing pre- and post-harvest losses would make more wheat available for consumption.

ACKNOWLEDGEMENTS

Research presented in this manuscript is supported by Semnan University, Iran is gratefully acknowledged.

REFERENCES

Aslam, M., Majid, A., Hobbs, P.R., Hashmi, N.I. and Byerlee, D. 1989. *Wheat in rice- wheat cropping system of the Punjab: a synthesis of on-farm research results 1984-1988*. PARC/CIMMYT Paper No. 89-3. Islamabad, Pakistan Agricultural Research Council.

Borlaug, N.E. and Dowswell, C.R. 1996. The acid lands: one of agriculture's last frontiers. *In* A.C. Moniz, A.M.C. Furlani, R.E. Schaffert, N.K. Fageria, C.A. Rosolem & H. Cantorella, eds. *Plant-Soil Interactions at Low pH. Proc. 4th Int. Symp.* Belo Horizonte, Brazil, the Brazilian Soil Science Society.

Briggle, L.W. 1980. Origin and botany of wheat. *In* E. Häfliger, ed. *Wheat documenta cibageigy*, p. 6-13. Basle, Switzerland.

Briggle, L.W. and Curtis, B.C. 1987. Wheat World Wide. *In* E.G. Heyne, ed. *Wheat and wheat improvement*, 2nd ed. *Agronomy* 13: 1-32.

CIMMYT. 1978. *CIMMYT* report on wheat improvement,. Mexico, DF.

CIMMYT. 1996. *CIMMYT 1995-96 world wheat facts and trends: understanding global trends in the use of wheat diversity and international flows of wheat genetic resources*. Mexico, DF.

Cook, R.J. and Veseth, R.J. 1992. *World health management*. St Paul, MN, USA, APS Press.

Curtis, B.C. 1982. Potential for a yield increase in wheat. In *Proc. Natl. Wheat Res. Conf.*, Beltsville, MD, USA, 26-28 Oct., p. 5-19. Washington, DC, National Association of Wheat Growers Foundation.

Dalrymple, D.G. 1986. Development and spread of highyielding varieties of wheat in developing countries. Washington, DC, Bureau for Science and Technology, Agency for International Development, US Government Printing Office.

Hanson, H., Borlaug, N.E. and Anderson, R.G. 1982. *Wheat in the third world*. Boulder, CO, USA, Westview Press.

Johnson, V.A., Briggle, L.W., Axtel, J.D., Bauman, L.F., Leng, E.R. and Johnston, T.H. 1978. Grain crops. *In* M. Milner, N.S. Scrimshaw & D.I.C. Wang, eds. *Protein resources and technology*, p. 239-255. Westport, CT, USA, AVI Publishing.

Kohli, M.M. and Mc Mahon, M.A. 1988. A perspective of research needs for non-irrigated tropical countries. *In* A.R. Klatt, ed. *Wheat production constraints in tropical environments*. Mexico, DF, CIMMYT.

Leonard, W.H. and Martin, J.H. 1963. *Cereal crops*. New York, NY, USA, MacMillan Publishing.

Miller, R.H. 1991. *Insect pests of wheat and barley in West Asia and North Africa*. ICARDA Technical Manual No. 9 (Rev. 2). Aleppo, Syria, ICARDA.

Nuttonson, M.Y. 1955. *Wheat-climatic relationships and the use of phenology in ascertaining the thermal and photothermal requirements of wheat*. Washington, DC, American Institute of Crop Ecology.

Orth, R.A. and Shellenberger, J.A. 1988. Origin, production, and utilisation of wheat. *In* Y. Pomeranz, ed. *Wheat chemistry and technology*, vol. 3. St Paul, MN, USA, American Association of Cereal Chemists.

Percival, J. 1921. The wheat plant. A monograph. New York, NY, USA, E.P. Dutton & Company.

Peterson, R.F. 1965. Wheat botany, cultivation and utilization. New York, NY, USA, Inter Science Publishers.

Saunders, D.A. and Hettel, G.P., eds. 1994. Wheat in heat stressed environments: irrigated, dry areas and rice-wheat farming systems. Mexico, DF, CIMMYT.

Tandon, J.P. 1993. Wheat cultivation, research, organisation, and production technology in the hot dry regions of India. *In* D.A. Saunders & G.P. Hettel, eds. *Wheat in heat-stressed environments: irrigated, dry areas and rice-wheat farming systems*, p. 17-23. Mexico, DF, CIMMYT.

Corresponding author: Hamid Kheyrodin, Faculty of Desert Science, Semnan University, Semnan, Iran
Email: hkhyrodin@yahoo.com