



PLAN FOR A NEW FOOD REVOLUTION

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In 2012, Sir Gordon Conway authored a book entitled, “One Billion Hungry—Can we feed the world?” The world human population is expected to reach 9 billion people by the year 2050. In the summary of his book, he stated that, in the future, the world will need to double the amount of grain produced to meet the demands of this increased population. He listed nine points that should be followed to achieve the desired result. To replace the old Green Revolution proposed by Dr. Norman Borlaug with a new plan will require new sources of arable lands and water.

One way to achieve this is to find a way to use land that has saline or alkaline soils. For 27 years, I conducted a shuttle breeding program between Brawley, California (33N latitude) during the Canadian winter season (short days during October, November, December, and part of January) and Ottawa, Ontario (45N latitude) during the summer season (long days during May to September) to produce oats that will flower well under both short and long day lengths (Figure 1). All oat material in Brawley, including hulless strains, was grown on soil that was mildly saline, and the irrigation water from the Colorado River was alkaline. I selected healthy, space-planted plants each year in the nursery and sent the seed back to Ottawa for evaluation. I did not realize at the time that I was also apparently selecting for salt tolerant plants over the many years that I ran the nursery.



Figure 1: The flowering response of a daylength insensitive oat carrying the gene Di-1 (left panel) and that of a daylength sensitive plant not carrying the gene (right panel). The plants were grown in Brawley, California (33N) during the months of October to March. Both plants will flower normally during the summer in Ottawa (45N). Di-1 was found in a specimen of *Avena byzantina* growing in Bodrum, Turkey.



Dr. Changzhong Ren, director of the Baicheng Academy of Agricultural Science, came to Ottawa to study, then returned to China with some seed from the Ottawa program. In the western parts of regions of Jilin Province in China, soil degradation, desertification, salinization, and alkalization are very serious problems for crop production. However, Dr. Ren found that one of my selections, VAO-2 (later named AC Gehl after registration), grew well when planted on these soils and produced seed (Figure 2). No irrigation was used for these trials.



Figure 2: Naked oats growing on saline and alkaline soils (pH 8.5-9.1).

I used many accessions from seed banks in the shuttle breeding program over the years, but I cannot now identify the source of any potential salt or alkali resistant genes. It is likely that many of the selected lines derived from material from this nursery are resistant to salt and alkali. One of these is VAO-8, which is also a daylength insensitive line. Daylength insensitivity could also be advantageous for expanding the area suitable for oat cultivation.

Grain is important for feeding animals as well as people. Andrew Lawler, in an article in *New Scientist* (March, 2015), states that there is now a very large amount of chicken meat consumed by humans (100 million tonnes per year) in many countries in the world. Consumers are adding chicken and eggs to the human diet at just about every meal. Chicken meat is now the third ranked animal meat added to the human diet and humans consume one trillion eggs per year. This is an ideal animal to feed millions of people because it is convenient, can be raised in any farm yard, and is consumed in one meal. It requires less space to rear and the meat requires less, if any, refrigeration compared to cattle meat. Chickens and their eggs are very nutritious



and the birds are efficient converters of feed into meat and eggs. Hulless oats are an excellent feed for chickens as well as people, as described in a monograph by Burrows, *et al.* (1993).

All aspects of this food plan are brought together in Figure 3. It is based upon people consuming chicken products fed with daylength insensitive hulless oats that were bred on saline and alkaline soils, such as AC Gehl and VAO-8. A recent UN press release (<http://inweh.unu.edu/world-losing-farm-soil-daily-salt-induced-degradation/>) states that the world is losing 4000 hectares of arable land per day and in the past 20 years has lost 62 million hectares of arable land to salinity and alkalinity. The plan presented here will possibly bring into use millions of hectares of degraded land around the world.

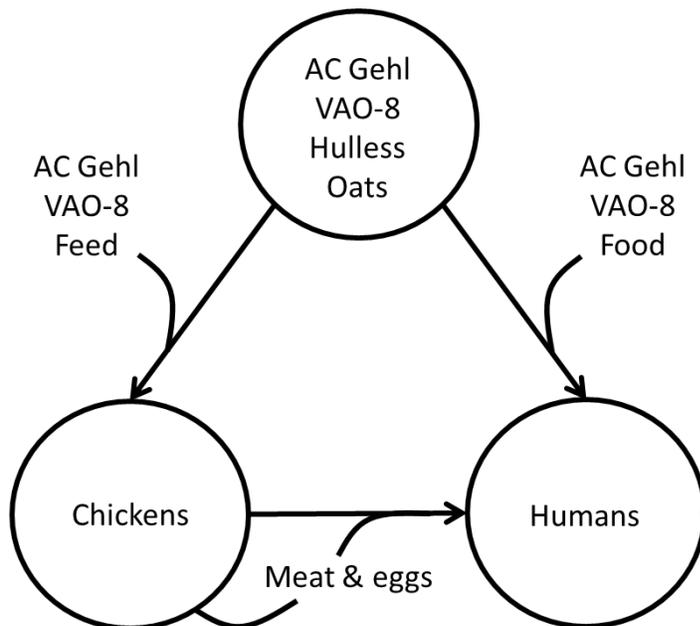


Figure 3: Proposed food program for short season areas using saline and alkali tolerant oats, such as AC Gehl and VAO-8.

References:

Conway, G. (2012) *One Billion Hungry—Can we feed the world?* Ithaca, NY: Cornell University Press.

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