A chapter from

Adaptation of Chickpea in the West Asia and North Africa Region

Edited by

N P Saxena, M C Saxena, C Johansen, S M Virmani, and H Harris

ICRISAT

International Crops Research Institute for the Semi-Arid Tropics
Patancheru 502 324, Andhra Pradesh, India

ICARDA

International Center for Agricultural Research in the Dry Areas
PO Box 5466, Aleppo, Syria

1996

6.1. Future Research Priorities for Chickpea in WANA and SAT

N P Saxena[1], M C Saxena[2], C Johansen[1], S M Virmani[3], and H Harris[4]

An objective assessment of the needs and opportunities in chickpea research is essential for formulating plans so that the productivity of the crop is sustained in all chickpea-growing regions, especially of the WANA region. To achieve this objective, information on different aspects of chickpea production has been analyzed and documented in the first five chapters of this book. These chapters also cover the status of the crop in 11 important chickpea-growing countries in WANA. An interpretative regional summary of biotic, abiotic, and socioeconomic constraints to chickpea production in the three WANA regions—West Asia (Section 2.6), North Africa (Section 3.4), and Nile Valley countries (Section 4.4)—and across the WANA and SAT regions (Chapter 5) has been presented. A similar study of chickpea production in South Asian countries was undertaken earlier by Virmani et al. (1991). In this chapter, we will evaluate the need for continued research on the crop and suggest future areas of research thrust.

Role of Chickpea in Agricultural Production Systems

Due to the increasing need for legumes, chickpea is no longer considered a subsistence crop. The upward trend in its trade (Section 5.8) suggests that the crop is grown increasingly for the market. Our study contests the general belief that increasing use of input responsive crops (particularly wheat) has relegated chickpea to marginal lands in the WANA region. Although the area and production of chickpea has decreased to some extent, its productivity and imports have been steadily going up (Section 5.8). Chickpea is now mostly cultivated as a sole crop in several countries.

Research Needs and Opportunities

The available statistics on chickpea area, production, yield, price, and trade (Section 5.8) show that in most of the countries studied (Chapters 2, 3, and 4), the demand for the crop is greater than the supply. It is predicted that this trend will continue in the near future. Yet, it is surprising that even though a favorable economic environment exists, there has not been a large-scale expansion in chickpea cultivation and production in areas where the crop is habitually grown, except in Turkey and Australia. This apparent contradiction reflects a gap in our understanding of farmers' needs. We have to identify urgently and correctly their needs and transfer to them appropriate technologies to overcome constraints at the farm level.

Demand and Uses of Chickpea

Demand for a crop is generated by the diversity of its uses. Chickpea is consumed in different ways (Jambunathan 1991), generally with cereals (wheat and rice). There are many other uses of chickpea such as in snacks and sweets. It is also used as livestock and poultry feed, but increasing prices have discouraged this use. There are a few reports on the commercial use of the crop in the preparation of baby food, starch, and in plywood industries. Demand, for chickpea therefore, seems to be primarily driven by its use as a food crop.

1. Agronomy Division, ICRISAT Asia Center, Patancheru 502 324, Andhra Pradesh, India.
2. Germplasm Program, ICARDA, PO Box 5466, Aleppo, Syria.
3. Soils and Agroclimatology Division, ICRISAT Asia Center.
4. Farm Resource Management Program, ICARDA.

Profitability of Chickpea Cultivation

The declining chickpea area and production, in spite of increasing demand, suggests that it may not be profitable to grow the crop in the prevailing production systems, because:

- improved technologies (varieties and management practices) either have not reached the farmers, or else
- farmers do not find them useful under their management conditions.

Research has shown that it is more profitable to grow chickpea than cereals and other nonlegumes in rainfed agriculture, because of its low dependence on expensive inputs (NP fertilizers) (Section 1.4). In the traditional chickpea-growing areas, e.g., in South Asia, the water requirement of the crop is low, due to the low evaporative demand of the atmosphere during the chickpea-growing season. Also, the cost of labor is generally low in the rainfed areas. These factors made chickpea a profitable crop in the past in low-input rainfed production systems. In many traditional chickpea-growing countries in WANA and SAT, this practice continued for many decades. Lately, however, irrigation and fertilizer, to which chickpea is not very responsive, are increasingly available. The cost of labor has also gone up coupled with increased disease incidence on chickpea. Due to these constraints, chickpea has lost its economic competitiveness vis-à-vis other crops in many countries and the area under it has consequently reduced.

Increasing demand for the crop in Turkey and Australia, however, has favored its expansion in these countries. In Turkey, where chickpea has been traditionally grown during spring, fallow lands have been replaced with spring-sown chickpea. In Australia, the crop was introduced in response to increasing demand from Asia. It is perhaps economical to grow the crop in Australia because of large-scale mechanized production.

Factors that determine productivity and profitability of chickpea depend upon the agroecological and socioeconomic environment in which it is produced. For example, in India (Section 5.8), a decrease in traditional chickpea-growing area (northern India) occurred due to lack of varieties responsive to high inputs. On the other hand, its cultivation increased in non-traditional areas in peninsular India (western and southern parts) due to the availability of irrigation in these warm subtropical environments. No radical change in production technology, chickpea varieties, or management technique, was involved in this large-scale area expansion in peninsular India. New areas where such opportunities exist or any improvements in existing technologies that would lead to the opening up of new opportunities need to be identified.

Factors that are important for boosting chickpea profitability in WANA are:

- Increase in productivity, and
- Reduction of production cost through
  - economic use of inputs, and
  - mechanization of field operations to reduce labor costs.

Increase in Productivity

Both genetic and agronomic options are available for enhancing yield and stability of chickpea production. In practice however, these are not two independent options but are components of an integrated crop management (ICM) strategy for increasing chickpea production.

Genetic options

Chickpea productivity can be increased through greater on-farm use of existing high-yielding genetic material. As past efforts for enhancing the genetic yield potential of chickpea have not been very rewarding (Saxena and Johansen 1990), the current emphasis in genetic enhancement research is mainly on the incorporation of resistance to known biotic and abiotic stresses.

Ranking of various biotic and abiotic constraints to chickpea production based on realistic estimates of yield losses, is a prerequisite for researchers and planners to set priorities and allocate resources in order to overcome these constraints. Such prioritization of biotic and abiotic constraints in cool-season food legumes, including chickpea, has been done on a global scale by Johansen et al. (1994). Similar prioritizing of constraints in national programs would be very useful.

Environmental stresses. Drought appears to be the most widespread constraint (Section 5.2; Johansen et al. 1994) because more than 90% of the world chickpea area is rainfed. Variations of inter- and intra-seasonal rainfall (quantity and distribution) in WANA and SAT are well documented. It is, however, a matter of great concern that drought has not been accorded a high priority in applied research. Methods to alleviate drought effects, through escape and resistance mechanisms, are now available (Section 5.2) and could be exploited on farm. Problems related to temperature (heat, cold, and frost) effects on chickpea production are region-specific. Salinity is important only in some countries, (e.g., Iran). It should be given a low priority in breeding programs as salinity-resistant germplasm material is not available.

Diseases. Diseases appear to be the most important constraint that causes yield instability (Section 5.3). Concerted efforts are needed for enhancing resistance to diseases. Fortunately, sources of resistance to many of the soilborne and foliar diseases are now available, including multiple disease-resistant material (Table 5.3.3 in Section 5.3). For such diseases as ascochyta blight (*Ascochyta rabiei*) and botrytis gray mold (*Botrytis cinerea*), the resistance levels are low. Strategic research to increase levels of resistance through gene pyramiding is necessary. Instances of break-down of disease resistance (due to new races or pathotypes) are often reported. Durable resistance needs to be ensured in germplasm enhanced for disease resistance. Fusarium wilt (*Fusarium oxysporum*) is most widespread across the SAT and WANA regions. Most progress has been made in developing varieties with durable resistance to this disease. Yield losses caused by nematodes remain to be quantified. Progress in mapping the cyst nematode (*Heterodera ciceri*) (in WANA) by ICARDA and the root-knot nematode (*Pratylenchus* spp) (in SAT) by ICRISAT, and screening of germplasm should help in controlling these nematodes effectively.

Insect pests. Differences in insect pest importance (Section 5.4) between WANA—for leafminer (*Liriomyza cicerina*) and SAT — for pod borer (*Helicoverpa* spp) — emphasize the regional differences in their distribution. *Callosobruchus* spp (stored grain pests) are common across WANA and SAT. Yield losses caused by various insect pests remain to be correctly estimated. Acceptable levels of resistance have not been found for any of these insect pests, but some genotypes with low levels of pest incidence have been identified.

Nutrient use and fertilizer economy. In recent years, research on biological nitrogen fixation (BNF) has helped to quantify its benefits to the nitrogen economy of the chickpea crop and the sustainability of production systems (Section 5.5). To enhance BNF benefits, it is necessary to identify high-nodulation material that increase yields, with tolerance for high soil nitrate levels to ensure an adequate symbiosis. Inoculation responses observed in WANA suggest large potential benefits of this cheap technology. Therefore, research on BNF needs to be strengthened in national programs. Interaction of BNF with drought and temperature suggests that screening of