National Seminar on

Technologies for Enhancing Oilseeds Production Through NMOOP

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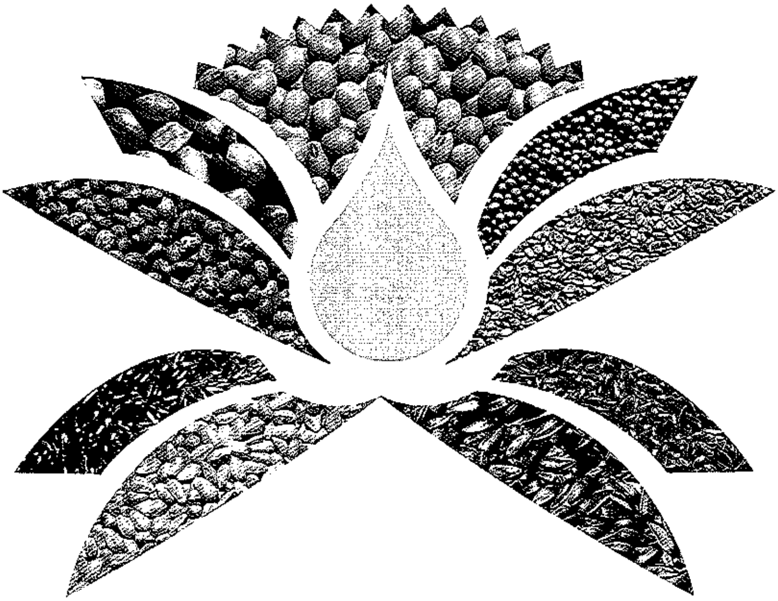

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ICAR-Indian Institute of
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Indian Council of Agricultural Research
Rajendranagar, Hyderabad

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Global Perspectives on Groundnut Production, Trade, and Utilization: Constraints and Opportunities

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Abstract

Globally groundnut is the second most important oil crop. Africa and Asia together contribute about 91% of the global groundnut production. There exists large variability in production and productivity across regions and countries. Several factors contribute to this variation in productivity, which in large part probably could be addressed by developing greater input- and resource-use efficient cultivars. Concerted efforts are being made to develop such cultivars which should be popularized to make groundnut production more competitive and profitable to farming community. Availability of seeds of improved cultivars and adoption of integrated crop management technologies together with enabling policy environment are expected to accelerate and stabilize production. Groundnut is a wholesome food, increasingly being used in many parts of the world. Aflatoxin, a serious quality problem, adversely impacting both health and trade, should be addressed appropriately. Groundnut exporting countries need to explore new markets and develop new groundnut-based products to revive groundnut economy.

Introduction

Groundnut is the second most important annual oilseed crop after soybean. Analysis of the last ten years (2004 to 2013) average world groundnut production provided interesting facts:

65% production from Asia; 26% from Africa; and 8% from Americas. Large differences in productivity were also noted across the continents. The global average productivity stands at 1.62 t/ha. Americas recorded impressive productivity growth of close to 3 t/ha, with Asia 2.1 t/ha, and Africa 0.95 t/ha. Oceania region contribute very little to world groundnut production but the average productivity stand at 1.76 t/ha. In Asia, China and India both contribute to 58.3% to global groundnut production (39.0 m t), with China producing maximum groundnut (14.8 m t). The average groundnut productivity in China is 3.35 t/ha, close to three times more than that of India (1.22 t/ha). Other countries with substantial groundnut production in Asia include Indonesia (production 1.35 m t; yield 2.15 t/ha), Vietnam (0.49 m t; yield 2.2 t/ha), and Myanmar (production 1.2 m t; yield 1.5 t/ha). The major groundnut production in Africa comes from Cameroon, Chad, Democratic Republic of Congo, Ghana, Malawi, Mali, Niger, Nigeria, Sudan (former), Uganda and United Republic of Tanzania. The average yields in most of these countries is about 0.7-0.8 t/ha, with yield being the lowest in Niger (0.45 t/ha) and highest in Cameroon, Ghana, and Nigeria (1.2 to 1.4 t/ha). USA, Argentina, and Brazil are the major groundnut producing countries in Americas, with USA producing on average close to 2 m t, Argentina 0.59 m t, and Brazil 0.29 m t. The groundnut productivity in USA is 3.8 t/ha, while about 2.5 t/ha in Argentina and Brazil. Australia is the largest producer in Oceania (24,300 t), with average yield close to Argentina and Brazil.

Groundnut in India is predominantly grown in Andhra Pradesh, Gujarat, Karnataka, Maharashtra, Odisha, and Tamil Nadu, contributing to 80% of total groundnut production in India. About 74% of the total produce is harvested from rainy season crop, while only 26% from the irrigated post-rainy season crop. The average productivity during the post-rainy season is about two times (1.8 t/ha) more than rainy season (0.8 t/ha). Recent trends in average (2011-2013) productivity amongst the major groundnut producing states revealed highest productivity (1.85 t/ha) in Tamil Nadu, about 1.0 to 1.2 t/ha in Gujarat, Maharashtra, and Odisha, and between 0.72 to 0.83 t/ha in Andhra Pradesh and Karnataka. Other states with average productivity greater than 1 t/ha include Chattisgarh (1.15 t/ha), Rajasthan (1.37 t/ha), and West Bengal (1.65 t/ha), which should be targeted for intensification of groundnut production. Of recent, groundnut acreage has declined largely because farmers switched to more profitable crops like *Bt* cotton in some of the major producing states such as Gujarat.

The production constraints

Groundnut is extensively grown in the semi-arid tropics by resource-poor farmers where many abiotic and biotic factors limit its productivity and seed quality. The major abiotic factors affecting groundnut production include drought, low availability of phosphorous especially under acidic soil conditions, salinity and temperature stress (both low and high). In calcareous soils, the groundnut crop is also affected by iron-induced chlorosis. Rust, late leaf spot (LLS), and early leaf spot (ELS) are widely distributed foliar diseases. Groundnut rosette disease (GRD) is the most destructive disease of groundnut in Sub-Saharan Africa. Bacterial wilt of groundnut is prevalent in East and South East Asia region, while peanut bud necrosis disease in South Asia. Unlike diseases, insects are of localized importance. The only groundnut insect pests of significant economic importance are leaf minor in South Asia; *Spodoptera* in South-east Asia, termite in Africa, and cornear worm, lessor corn stock borer, and southern corn rootworm in USA. Nematodes are of importance in USA. Sucking pests such as aphids, jassids, and thrips are not themselves considered economically important but are carrier of virus diseases such as aphids for GRD (Dwivedi *et al.*, 2003).

Most of these stresses often occur in combinations and their severity and extent of distribution vary with cropping systems, growing seasons, and regions. Global yield loss caused by these stresses is enormous, for example, yield loss due to rust and LLS together has been projected at US$ 1066 million, of which ~50% can be realized through genetic enhancement. Development of groundnut cultivars with multiple resistances would provide enhanced and sustainable production of groundnut to subsistence farmers in India (Dwivedi *et al.*, 2003).

Lack of availability of quality seeds of improved cultivars during the crop season is the major constraint to popularizing cultivation of improved groundnut varieties, because of this, the old and traditional varieties are still grown in many parts of the world.

Aflatoxin impacting global trade and human health

Aflatoxin (B_1, B_2, G_1, G_2) is a serious quality problem in groundnut, with B_1 the most toxic of aflatoxins. Aflatoxin in food can cause death, impair growth and development of children, suppress the immune system, enhance infection with hepatitis B (HBV) and hepatitis C (HCV) viruses, increase risk to certain types of cancer by several fold, and impede the uptake and utilization of micronutrients in humans and livestock (Williams *et al.*, 2004; Fokunang *et al.*, 2006; Liu and Wu 2010; Wu *et al.*, 2011). Furthermore, the evidence to date suggests that global warming will lead to more aflatoxin in groundnut and maize (Dwivedi *et al.*, 2013 and references therein). To address aflatoxin contamination in groundnut, adopting research and management options may lead to minimize the risk of aflatoxin contamination under changing climate in groundnut. These include among others modeling climatic risks to aflatoxin contamination, using geostatistical and geographical information systems to monitor spatial variability in aflatoxin, using high-throughput and cost effective assays to detect aflatoxin, using atoxigenic fungal strains as biocontrol agents to manage aflatoxin contamination, and finally adopting a system-based approach to control aflatoxin contamination (Dwivedi *et al.*, 2013). It is beyond the scope of this paper to discuss in detail about these measures but one aspect that may generate interest lies is using high-through cost-effective aflatoxin kit, *cELISA* (Waliyar *et al.*, 2009), to monitor aflatoxin contamination in groundnut. The kit is simple and inexpensive, with lower detection limit (1.0 μg/kg) and costs (about US$ 1 per sample) less than other available methods, with high throughput efficiency (>100 samples per day). This kit has provided unique opportunity to researchers in the developing world to select breeding populations possessing resistance to aflatoxin contamination, and to evaluate food, feed and related commodities for aflatoxin contamination. Researchers in India and some countries in Africa have successfully adopted this technology, contributing to the quality certification of farmers produce in domestic and international markets. Groundnut contaminated with aflatoxin drastically limits the access of producers to the global markets, where high standards for food safety have been set.

Human health and nutritional quality

Groundnut has several uses and consumption pattern worldwide, i.e., oil, peanut butter, roasted and salted nuts, in-shell boiled or in-shell roasted nuts, and other confectionery products. For example, groundnut in US is predominantly consumed as peanut butter, with shelled and salted nuts, candy, and roasted-in-shell or boiled-in-shell nuts the next most common uses compared to use as oil elsewhere. The consumption pattern in developing countries has also changed from oil to food uses. For example, it used to be predominantly an oil crop in 70's and 80's but now more in the form of roasted-in-shell or boiled-in-shell nuts in Africa, Asia, the Caribbean and pacific regions of the world. World health organization encourages use of 'ready-to-use therapeutic food' (RUTF), such as Plumpy'nut®, manufactured by a French firm, Nutriset, for community-based treatment of severe malnutrition, which contains the right mix of nutrients to treat a child with severe acute malnutrition, and in a form that is easy to consume and safe. More importantly, RUTF has shown the potential to improve under nutrition among HIV-positive children (reviewed in Dwivedi et *al.*, 2014)

Humans require at least 49 nutrients to meet their metabolic needs, and inadequate consumption of even one or a combination of these results large economic cost to the society (Welch and Graham, 2004). Groundnuts are a natural and wholesome food, rich in protein, oil, minerals (P, Ca, K, Mg, Fe, Zn, Cu, Mn, and Se), vitamins (B_1, B_2, B_3, B_5, B_6, choline, E, and folate), and fiber. Regular consumption of groundnut is associated with reduced risk of cardiovascular diseases, lower blood pressure, cancers, and also benefits those with type II diabetes. Groundnut consumption has also been associated with body weight maintenance; i.e., malnourished infants achieve weight gain, while obese adults and children achieve weight loss (reviewed in Dwivedi *et al.*, 2014).

Palmitic, oleic (O) and linoleic (L) fatty acids together contribute to approximately 90% of the total fat in peanut. Oleic acid has been associated with increased shelf life of the products and imparts health benefits, while linoleic acid is associated with developing off flavors during storage due to oxidation. A germplasm line with high O/L ratio has a longer shelf life than those with low O/L ratios. A breeding line with exceptionally very high O/L ratio (80:1) was found in 1990's which has dramatically changed the nutritional profile of the produce from newly developed cultivars in USA. Using this source and conventional crossing and selection, the US breeders have successfully developed several high-yielding cultivars into three major market types (Virginia, Spanish, and Valencia) cultivars (Dwivedi *et al.*, 2014). A US groundnut cultivar (SunOleic 95R) with O/L ratio of about 25, originating from cross breeding with high O/L ratio line, is available with ICRISAT and breeders at ICRISAT are extensively using this source to transfer high O/L ratio in locally adapted cultivars in India. Efforts at ICRISAT are also being directed towards selecting for high oil content, and some groundnut varieties with average oil content of up to 55% were selected. More recently, Huang *et al.* (2012) reported an accession from wild species, *A. rigonii* with an exceptionally high oil concentration (three years average, 62%), which could be tried to further enhance oil content in groundnut.

Micronutrient deficiency occurs widely in the developing world. Both Fe and Zn are important micronutrients affecting human health. The evaluation of mini core collection at Patancheru, India led to the identification of 23 accessions high in both Fe (≥25.9 mg/kg) and Zn (≥34.2 mg/kg), with some of them having superior agronomic traits. ICG# 4750, 7963, 14705, and 15419 were highly diverse, contain high Fe and Zn, and were stable for either or both nutrients and their field performance was as good as the controls (Upadhyaya et *al.*, 2012).

Groundnuts are a good source of biologically active compounds such as arginine, resveratrol, phytosterols, and flavonoids, which could be used as a functional food to prevent and manage some of the common diseases of modern day society. The plant polyphenol *trans*-resveratrol (3, 5, 4′-trihydroxystilbene), mainly found in grapes, peanuts and berries and mostly concentrated in the skin, displays a wide range of beneficial effects on humans. There has been little research on variation in *trans*-resveratrol in peanuts. Some genetic variation for resveratrol have been noted among select germplasm, for example, rutin and *trans*-resveratrol significantly higher in runner cultivars while quercetin in Valencia cultivars. These results provide evidence that targeted evaluation of peanut germplasm, such as in the core or mini core collections, should assist in identifying germplasm accessions with high levels of bioactive compounds for use in crop breeding (Dwivedi et *al.*, 2014).

Some people are allergenic to groundnut, for example in USA, approximately 1% of the children and 0.6% of adults are affected, while in UK, about 1.8% of children from peanut allergy. Twelve type of peanut allergens have been documented, of which Ara h 1, Ara h 2, Ara h3, and Ara h 13 the major allergens and represent highly homologous classes of seed storage proteins. Practically, no genetic variation (except for Ara h 1 in an Indonesian groundnut) were detected within limited peanut germplasm screened for peanut allergens (Krause et *al.*, 2009). Given that natural genetic variation is rare, inducing variation by TILLING or through transgenic approach may become the most expedient approach for altering allergen composition.

Carotenoids are an important source of vitamin A. The consumption of carotenoid-rich food is associated with reduced risks of developing cancer and cardiovascular disease, enhanced immune response, improved vision and prevention of night blindness as well the maintenance of healthy skin and gastrointestinal or respiratory systems (Menkir *et al.*, 2008 and references therein). Carotenoids are *fat-soluble and β-carotene is the most efficiently* converted to vitamin A. Carotenoid biosynthesis pathways have been successfully modified by genetic engineering to enhance the nutritional profiles of staple food crops (Dwivedi *et al.*, 2012 and references therein). Groundnut has no natural genetic variation for β-carotene.

Groundnut seed contains about 45-50% oil, with most of its oil used in domestic cooking in the developing world. Thus, it is a good candidate for transforming it into a β-carotene rich crop, as evidenced in *Brassica napus*, with 19 to 30 fold increase in carotenoids (predominantly β-carotene) compared with untransformed plants (Fujisawa *et al.*, 2009). Using maize phytoene synthase gene (*psyl*) driven by an *At oleosin* promoter (for seed-specific expression in oil bodies), the researchers at ICRISAT has developed transgenic events in JL 24 background which show a multi-fold (up to 5.4 µg/g) increase in β-carotene as compared to the untransformed control. Encouraged with this success, further work is in progress to transform micronutrient-dense (Fe and Zn) lines to develop super nutritious groundnut (rich in Fe and Zn and β-carotene). High β-carotene peanut seed or oil is expected to be effective for delivering this essential vitamin to millions of people in the developing world with significant local peanut production and domestic consumption (Dwivedi et *al.*, 2014).

Biotech interventions to developing input- and resource-use efficient groundnut cultivars

Researchers to date using conventional breeding has made moderate progress towards developing region-specific groundnut varieties, some combining multiple resistance to stresses and having broader adaptation and acceptance among farmers. For example, varieties that mature early and tolerant to drought, rust and LLS; early maturity, drought tolerance and resistance to aflatoxin; or confectionary types with tolerance to foliar diseases. Varieties combining resistance to GRD or bacterial wilt and other appropriate stress are available and grown in Africa (GRD) and in East and South-east Asia. In USA, varieties combining resistance to rust and leaf spots, tomato spotted wilt virus, and nematodes are widely grown. Further accelerated gain could be achieved if biotechnological tools are integrated with conventional breeding approach. Genomic research during the last decade has enabled groundnut move from 'genomic-resource poor' to 'genomic-resource rich crop', with abundant DNA markers which are being used to introgress QTLs associated with agronomically beneficial traits into high-yielding genetic background in groundnut. For example, the researchers at ICRISAT has introgressed a major QTL for rust resistance in three popular varieties of groundnut (ICGV 91114, TAG 24, and JL 24) (Varshney *et al.*, 2014). The evaluation of introgression lines showed 20-96% greater pod yield over the recurrent parents (JL 24, TAG 24, and ICGV 91114) and recorded a disease score of 2 (on 1-9 scale) similar to donor parent (GPBD 4). Likewise, marker-aided introgression of alleles enhancing oil quality (as measured by variation in O/L ratio, the higher the ratio longer the product shelf-life) has been undertaken to improve the oil quality of some popular varieties in India. The US researchers have been successful in improving nutritional quality of a nematode resistant groundnut variety using marker-assisted backcrossing.

Most groundnut crop is grown under rainfed conditions and drought is one of the serious abiotic constraint to groundnut production. Using *DREB1A* gene, the researchers at ICRISAT has developed transgenic events (JL 24 background) which when evaluated in confine and drought stressed conditions showed more conservative water use and produced 24% greater pod yield over untransformed control, JL 24. Aflatoxin is a serious quality problem in groundnut, with potential to significantly impact health and trade. Transgenic events carrying *PnLOX3* gene under drought stressed conditions showed significantly lower aflatoxin (<20 ppb) compared to susceptible control JL 24 (>75 ppb). All these events are currently being further evaluated prior to their use in breeding programs to introgress these traits into popular groundnut varieties in India.

Adopting integrated genetic and natural resource management practices to enhance groundnut production and quality

Soil fertility, water, nutrients (both macro and micro nutrients) management, and production related constraints (abiotic and biotic) largely influence the production and productivity of the crops, including groundnut. Bulk of the oilseeds produce come from rainfed agriculture. Crop management under rainfed condition is therefore very crucial to the success of rainfed agriculture. Some of the best practices under such conditions include timely planting; adoption of crop rotation to improve soil health and reduce pest and diseases buildup, adoption of conservation agriculture to arrest soil erosion and moisture loss; maintaining adequate plant stand; weed management; and plant protection to manage pests and diseases. Adoption of Integrated Genetic and Natural Resource Management (IGNRM) is the key to the success of groundnut cultivation under rainfed conditions. A temperature range of 25-30 °C is optimum for crop growth and development. Temperature above 35 °C is detrimental to groundnut production.

Groundnut crop responds to residual soil fertility better than the direct application of fertilizers. The crop(s) preceding groundnut should be well fertilized to build up soil fertility particularly for phosphorous and potassium. Application of fertilizers and their dose should be based on the nutrient status of the soil and the targeted yield. Calcium is essential for good seed development. Application of 200-400 kg/ha gypsum at the peak flowering stage as side placement is recommended. Groundnut responds to micronutrient application, particularly boron, zinc, sulphur, and iron; however, their use should be based on soil test. The seed should be treated with appropriate fungicides to minimize losses due to soil borne diseases. Host plant resistance (resistant cultivars) together with judicious use of fungicide/insecticide application will maximize production and minimize production cost. A 2-3 week moisture stress soon after crop emergence followed by regular irrigation, often helps in inducing profuse flowering and uniform pod maturity. At pegging and pod/seed development stages, light but frequent irrigation is needed. Excessive irrigation at later stages of crop growth may promote pod/seed diseases at maturity. The preferred method of irrigation is sprinkler irrigation (Nigam *et al.*, 2004).

Harvesting groundnut at optimum maturity and adopting appropriate postharvest practices for drying, threshing, grading, and storage, etc are very crucial to avoid losses and minimize the risk of aflatoxin contamination. For determining appropriate harvest time, a few representative plants from different spots in the field should be harvested and checked for black color in the inner side of the pod shell, an indication of maturity. The crop should be harvested when about 75-80% pods in case of Spanish/Valencia and 70-75% pods in case of Virginia cultivars show darkening of internal pericarp. Over maturity or delay in harvesting can result in greater pod loss in the soil and deterioration in pod quality. For drying and curing, lift and invert the harvested plants with pods uppermost in windrows for about 2-3 days, thresh it, and then sun dry for 3-4 days to bring moisture less than 10%. In post-rainy season the temperatures during harvest time are high, the harvested plants should be assembled in circular heaps with pods inside so as to avoid their direct exposure to the sun. Further, the pods should be shade-dried after threshing to avoid loss of seed viability. The clean produce should be stored in gunny bags in a well ventilated storage rooms (Nigam *et al.*, 2004).

Minimizing production cost by maximizing use of small farm equipment's to groundnut production

Groundnut is a labor intensive crop, and availability of manpower in agriculture is a serious constraint, forcing many agrarian families to abundant agriculture in favor of practices/occupations that earn them more money. Application of pre- and post-emergence weedicides will go a long way to minimize labor use in groundnut cultivation. The introduction of small-farm equipment's such as threshers (for stripping the pods), shellers (for shelling the seeds), and seed graders (for grading the seeds of different sizes) will minimize labor use. More importantly, these facilities are also available on hire basis and are increasingly being used by many farmers in India.

Public-private-partnership for diversification and value addition to introduce groundnut as health food

Groundnut is considered a wholesome health food and therefore immense opportunities exist to exploit public-private partnership for the development of new edible products at easily affordable cost. Unlike in the past, the private sector (mostly business houses involved in groundnut trade) have begun to support projects, from cultivar development to contract farming for bulk production (specific type of groundnut seeds) to value addition for enhancing the nutritional quality of the products. Opportunities should be looked for this kind of public-private partnership in groundnut to come up with new products for the benefit of rural and semi-urban populations in India. The predominant use of groundnut is oil, with more than 70% being crushed for oil purpose. Currently, the groundnut is not traded based on oil content *per se*. The work at ICRISAT has clearly shown that it is possible to develop groundnut cultivars with oil content as high as 55% (unlike on average 45%) and there could be opportunity for private sector to organize bulk production of such cultivars through contract farming to meet their seed requirement to run oil mills at commercial scale. Further, research at ICRISAT is in progress to develop early maturing varieties with high oil content (Upadhyaya, unpublished). Other avenue for partnership may be value addition or developing new health product such as Plumpy'nut®, 'ready-to-use therapeutic food' (RUTF), manufactured by Nutriset (a French firm) or any other groundnut-based ready to eat product will benefit for the welfare of the rural and urban poor and middle class family in SAT countries.

Groundnut trade

Groundnut is traded in the form of edible groundnuts (shelled and in-shell), edible oil and groundnut cake. The trade during 2003-2005 was predominantly of shelled groundnut (56%). Groundnut oil and oilcake meal each has almost an equal share in the groundnut trade. Asia accounts for over half of the global exports of confectionery groundnut. Latin America and Caribbean countries control one-fifth of the global exports, followed by North America. United States is the single largest exporter of confectionery groundnut from North America, and Argentina and Brazil from Latin America. The export and import of groundnut is highly concentrated. The seven largest net exporters of groundnut are China, Argentina, USA, India, Vietnam, South Africa, and Gambia. These countries together supply about 85% of the world export trade. Likewise, the six largest net importers (European Union, Indonesia, Canada, Singapore, Malaysia, and Philippines) purchase about three quarter of the current world imports. Of recent, there has been significant change in the positioning of the largest net exporters, for example, China lost over half of its share in the export market of hand-picked selected (HPS) kernels, while India moved to the second place. Argentina and Vietnam doubled their shares, while exports from USA decreased slightly, due to strong competition from Argentina. Groundnut oil is thinly traded in the international markets, largely because the major producers such as China, India and USA consume substantial amounts in their domestic markets. This consumption reduces the quantity available for export. In 1960s and 1970s, groundnut oil was the major item traded, as edible groundnut trade was negligible, but since then reverse has happened. Edible groundnut dominate the world groundnut trade while groundnut oil is of minor importance. WTO agreement also impacted groundnut trade largely due to agreement on Sanitary and Phytosanitary Measures (Diop *et al*., 2004; Varghese, 2011).

Varghese (2011) provided a detailed account on growth pattern of export of groundnut from India which revealed that the export of HPS grade groundnut kernels during pre-liberalization period (1980-81 to 1990-91) decelerated as evident by negative growth, largely due to government policy of channeling export through NAFED and export by private houses was totally banned (Chandrashekhar, 1989). In the post liberalization period (1991-92 to 1194-95), both export of HPS grade kernels and in shell HPS recorded impressive growth: the former 42.6% in terms of quantity and 43.1% in terms of value, while the latter 42.4% in terms of quantity and 42.5% in terms of value. This resulted in sharp increase in export of total groundnut from 4343 tons in 1993 to 2.4 lakh tonnes in 1994. Several factors including positive contribution from technical mission on oilseeds (TMO) contributed to record production during 1992-93. The export of HPS grade kernels from India during WTO period (1995-96 to 2001 to 2010) was much lower (9.2% by quantity and 11.4% by value) than those witnessed during the pre-WTO period, which was largely due to restriction imposed by EU countries about the limit of aflatoxin contamination (2 ppb for aflatoxin B_1 and 4 ppb for other aflatoxin) in groundnut. Other factors contributing to decline in export of HPS grade kernels is reduction in world production of groundnut, the steep rise in international prices of groundnut oil, forcing India to divert the produce into crushing for oils.

A clear shift in importers of Indian HPS grade kernels was also noted over period of time. United Kingdom and the Netherlands used to be one of the major importers of Indian groundnut in pre-liberalization period, the share declined in post WTO period largely due to strict limit imposed by UE on aflatoxin contamination. India now exports most of it HPS grade kernels to East-Asian countries such as Malaysia and Indonesia due to less restriction on aflatoxin contamination. To sustain HPS export in long run, it is however necessary that countries should aim towards quality production so as to meet standards set by EU countries. India should also identify new markets and consumers preferences to diversify and expand export of groundnut, both HPS grade kernels and in-shell groundnut.

Conclusions

Today, there is a greater need to develop resources- and inputs-use efficient cultivars to enhance production and productivity, and groundnut to be more competitive and profitable to farming community. Groundnut is a wholesome food. However, aflatoxin is a serious quality problem which should be addressed appropriately to minimize risk of aflatoxin contamination. Adoption of improved production practices and enabling policy environments are likely to sustain growth of groundnut. Immense opportunities exist to develop new health-promoting products involving groundnut as ingredients to diversify the basket of food products for the rural and semi-urban populations.

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