# Groundnut Plant Protection Measures Through Training Needs Assessment under Photowar Tract of Punjab, Pakistan

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**Abstract.** Groundnut (Arachis hypogea L.) being annual Kharif legume crop has not been given special attention in past. There are multiple uses of this crop worldwide and in Pakistan. It is an excellent cash crop for rain fed areas of Pothwar has potential to earn foreign attention to export. Present study was conducted to appraise the training desires of groundnut growers regarding its scientific plant protection technology. Respondents (240) were interviewed from Tehsil Jand of district Attock randomly. 41.25% growers were having fair level of knowledge that good storage conditions. There was excellent knowledge about insects (32.08%), for termite (27.08%) Chrotogonous good (28.75%), cutworm good (32.92%), hairy caterpillar poor (31.67%) vertebrates' pest satisfactory and (27.08%) Cercospora personata was satisfactory. Out of total surveyed farmers a little proportions of farming community were well aware of insecticide. Similarly, most of the respondent's knowledge was of satisfactory level except Cercodpora personata having (26.25%) excellent category familiarity. The results showed that there is need of training for farmers in case of plant protection measures. This study has concluded that institutions should play their role to educate farmers for adoption of advance production technology to get good production through plant protection of groundnut as cash crop.

**Key words:** Arachis hypogea L., Groundnut, Training needs, groundnut growers, Punjab, Pakistan.

## Introduction

Groundnut (*Arachis hypogea L.*) being an oilseed crop is commonly known as peanut, earthnut, moongphalli in Urdu. It is only cultivated species of Arachis. Globally, it is cultivated under arid and semiarid areas (Prased et al., 2001). This is native to South America (Weiss, 2000: 795-814). This is an annual plant with erect structure. It has distribution in temperate, tropical and subtropical zones. The subtropical areas situated 45oN and 35oS at 1000 meters above sea level, are groundnut producing countries. It is said that groundnut was domesticated long time before Spanish subjugation. The Spaniards took groundnut with them when they returned to Europe. Later the traders from Asia and Africa were the cause of spreading groundnut in both continents (Pattee et al., 1982: 455-456). Overall groundnut production is associated with rainfall and susceptible to severe drought, frost and standing water. It is grown on wide range of soil types (Madhusudhana, 2013: 7). It requires light sandy soils for good growth and yield, also grown on marginal lands (Prased et al., 2001: 623-627). Soil of rain fed areas which are mostly deficient in essential nutrients, moistures and organic matters are suitable for its cultivation (Ahmad et al., 1988). It has characteristic of biological nitrogen fixation process aiding in soil reclamation and improves soil fertility (Nourse, 1973: 11-13; Ntare, 2009: 13).

Pakistan is major groundnut producing country and due to various biotic and abiotic factors farming community is not able to get higher production in comparison to developed countries. During 2015-16, Rawalpindi division has an area of 190174 acres comprising of 197 acres irrigated and 188197 acres un-irrigated. Among districts of Rawalpindi division Attock has major role in production of groundnut. District Attock has total 49,679 acres among which 779 acres are irrigated while 48,900 acres are un-irrigated. Total groundnut production in Attock has 15108 tonnes (Govt. of the Punjab, 2016). Among the Tehsil of Attock, Jand has major contribution so there was need of study for training need assessment to solve the problem. The decline in groundnut production is due to social status of farming community. The groundnut producing farmers are less educated and have limited access to advanced production technologies. Meanwhile, the farming communities of groundnut producing areas have poor agronomic knowledge, and they don't have access to many of inputs required for its production. Due to less awareness about new high yielding cultivars the farmers grow old low yielding cultivars as well as they use their own field seed from the previous year which results into low crop productivity (Reddy et al., 1992). It is primary responsibility of agriculture extension workers that they should pay attention to upgrade skills of the farmers to increase production (GOP, 2008). Agricultural production is much low in Pakistan as compared to many other worldwide (Rehman, 2010: 112). The improved management practices for the production of quality groundnut include; use of quality disease free seed, land preparation, seed rate and its spacing, sowing method, fertilizer application, irrigation, weeding, disease control, harvesting, threshing, processing and storage. To perform these operation farmers, need trainings in relevant field which is the primary responsibility of extension field staff (GOP, 2008).

Agricultural Extension workers play an impotent role in training of farmers and also promote agricultural development by providing the extension services and information to the farmer. Extension worker helps farmers to increase the productivity of their farms and improve their living standards. Extension worker has many roles to play as advisor, technician, middleman, operating between agriculture research institution and the farmers (Anaeto et al., 2012: 180-185). He is a change agent helping farmers to identify their problems and solutions. Well intentional chances for partakers to gain important skill and understanding is referred as training (Hulme, 1992: 333-337). Training plays an important role in growth of human performance under certain situations. It offers a systematic assistance to partakers to work effectively and efficiently in their given task. It is important for trainees to utilize the knowledge and skill effectively in local communities. Training fills gaps between local and modern agricultural practices (Farinde and Ajayi, 2005: 159-164).

A huge number of advanced technologies have been developed by different government and non-government organizations with objective of uplifting economic status of farmers. But when these new advanced technologies were tested at farmer's field level there was a big gap between yield obtained at research station and at farmer's fields. This variation in yield of field crops pointed out presence of untapped potential (Maraddi et al., 2014: 177-180). An extension worker can fulfill this gap by providing new and updated knowledge.

Improved agricultural technologies have been proved as an important ingredient for the reduction of poverty in most of the regions of the world. It has also been noted that these new technologies were not adopted at once rather their adaptation was a slow and continuous process. Meanwhile, the advantages of adapting new agricultural technologies were nearly neglected or poorly understood (Foster and Rosenzweig, 1995:

1176). There could be many reasons of low adaptation rate of new technologies. Capital, less education, poor infrastructure would be considered the causes of low adaptation rate of new technologies (Diagne and Demont, 2007: 201-210).

**Material and Methods**

Due to large area under cultivation of groundnut research was conducted in Tehsil Jand of district Attock. Total area of Tehsil Jand is 571957 acres, out of which 240952 acres is cultivated land. Remaining area is barren land and under forest. Tehsil Jand is divided in to 02 markaz (Jand and Thatta) and 16 union councils. From markaz Jand 03 union councils were selected namely Jalwal, Narra and Sagri. Similarly, from Markaz Thatta 03 union council Pind sultani, Thatta and Domail were selected. From each union council 04 villages were selected. From each village 10 respondents were interviewed. It was difficult to collect data from the whole population so convenient sampling technique was used for the present study. A sample of 240 respondents was selected for obtaining required information. Before the survey, interview schedule based on production technology and problems associated with groundnut production was prepared reflect in the knowledge level of farmers and priorities of training program. After selection of specific area, farming community was interviewed at their farms and homes. Benefits of interviews were shared with them to clear their doubts. Asked question were made understandable to respondents in order to get more precise and accurate answers from farming community. Collected data was statistically analyzed by using Statistical Package for Social Sciences (SPSS). Conclusions and recommendations were made based on the analyzed data.

**Results and Discussion**

Results concerning demographic factors and knowledge level of groundnut growers about land preparation, variety selection, sowing time and method, disease free seed, seed rate, hoeing, fertilizer application, gypsum application at flowering, harvesting and storage practices, pests, diseases and their control were compiled after interviews of selected growers with the help of questionnaire. Data was analyzed, summarized and presented in tabular form. In this section results are interpreted and discussed in comparison to previous findings.

Storage of the viable harvested groundnut seed is important as later on at sowing time availability of good quality seed is ensured. Storage conditions and time of seed collection at harvest time are of prime importance for maintenance of viability. Inefficient storage structures and conditions impede quality of seeds for forthcoming plantation. Stored seeds must be protected against pests, insects, moisture and extreme temperature to guarantee germ inability. Unfortunately, no advanced storage system is available for groundnut growers to safeguard their produce for future use.

Presented data in Table 1 depicted that 41.25% respondents were having fair knowledge of proper storage. Similarly, poor storage knowledge was calculated 32.50% of interviewed respondents. Lowest knowledge level (2.50%) was recorded of excellent categories which is an alarming situation for major groundnut growing areas. Possessed mean (2.07) for storage of harvested groundnut reveals that higher trend between poor and fair knowledge levels.

Table 1. Rating, Possessed and Required Knowledge Level of Respondents about Storage, Insect Pests, Control Measure of Pests, Diseases and Control measures of diseases regarding Groundnut (n = 240)

| Storage | Knowledge level | | | | | Knowledge | |
|---|---|---|---|---|---|---|---|
| | P | F | S | G | E | Possessed | Required |
| | Percentage | | | | | Mean | |
| Storage at dry places with good ventilation facilities | 32.50 | 41.25 | 15.42 | 8.33 | 2.50 | 2.071 | 2.929 |
| *Insect pests* | | | | | | | |
| Cercodpora personata | 20.83 | 16.67 | 15.00 | 21.25 | 26.25 | 3.154 | 1.846 |
| Collectotrichum demmatra | 67 | 31.25 | 55.42 | 2.92 | 3.75 | 2.658 | 2.342 |
| Aspergilis niger | 6.25 | 32.92 | 56.67 | 2.08 | 2.08 | 2.608 | 2.392 |
| Fusarium sp. Verticillium alboatstrum Rhizoctonia soloni | 7.08 | 28.33 | 57.92 | 3.75 | 2.92 | 2.671 | 2.329 |
| *Control measure for pests* | | | | | | | |
| Bifenthrin, spray before rainfall | 19.17 | 20.83 | 22.50 | 17.50 | 20.00 | 2.983 | 2.017 |
| Permethrin, 3kg +10kg ash | 65.83 | 10.83 | 15.83 | 5.42 | 2.08 | 1.671 | 3.329 |
| Carbrgle 5kg+ash or permethrin | 68.75 | 11.25 | 7.92 | 6.67 | 5.42 | 1.688 | 3.313 |
| Light-trap or pyrethroid spray per cyno gas or bait | 60.00 | 13.75 | 8.33 | 12.50 | 5.42 | 1.896 | 3.104 |
| *Diseases* | | | | | | | |
| Cercodpora personata | 20.83 | 16.67 | 15.00 | 21.25 | 26.25 | 3.154 | 1.846 |
| Collectotrichum demmatra | 67 | 31.25 | 55.42 | 2.92 | 3.75 | 2.658 | 2.342 |
| Aspergilis niger | 6.25 | 32.92 | 56.67 | 2.08 | 2.08 | 2.608 | 2.392 |
| Fusarium sp. Verticillium alboatstrum Rhizoctonia soloni | 7.08 | 28.33 | 57.92 | 3.75 | 2.92 | 2.671 | 2.329 |
| Control measures of diseases | | | | | | | |
| Topsin M 2kg/kg seed treatment | 29.58 | 17.92 | 12.50 | 22.08 | 17.92 | 2.808 | 2.192 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Topsin or Benlate 2kg/kg | 25.42 | 30.00 | 17.50 | 14.17 | 12.92 | 2.592 | 2.408 |
| Benlate 2g/kg | 80.00 | 14.17 | 5.83 | 0.00 | 0.00 | 1.258 | 3.742 |
| Crop rotation, Topsin 2g/kg | 81.67 | 10.42 | 2.92 | 4.58 | 0.42 | 1.317 | 3.683 |
| P= Poor F= Fair S= Satisfactory G= Good E= Excellent | | | | | | | |

Whereas, required mean (2.92) was calculated mean exhibiting trainings are required to improve existing conditions. Government has to make decision to facilitate groundnut farmers with advanced storage systems. Well ventilated warehouse for in and outlet of air fitted with wire mesh and fumigation with pesticide to control stored pests are essential for successful storage. Removal of unnecessary substances from store should be removed to protect infestation losses. The results are in agreement with the findings of Sokoya et al. (2014: 33) whom confess lack of required knowledge for modern storage facilities and availabilities.

Insects and pests are major cornerstone against food insecurity creating competition with crop plants for higher production. Among the animals insects are most diverse found in all types of habitats. Old varieties of groundnut are more susceptible to various insects and pest comparative to high yielding crops that are more resistant. Number of insects and pest attack on groundnut crop in studied area were observed while interviewing farming community. Possessed mean (3.53) indicated in table.1 had the highest trend between satisfactory to excellent levels of knowledge about termites. Possessed mean (3.25) indicate maximum awareness between satisfactory and good knowledge levels about chrotogonous familiarity. Additionally, possessed mean value (3.04) depicted more trends between satisfactory and good knowledge about cutworms. Moreover, possessed mean (2.30) indicate that maximum knowledge exists between poor and fair knowledge levels about hairy caterpillar. Data shows that maximum 32.08% respondents were having excellent and 27.50% good knowledge of termite, whereas, minimum 12.50% were having poor termites knowledge. Moreover, highest (27.08%) farming community was having good level of chrotogonous. Similarly, 21.25 and 20.83% were satisfactory and excellent knowledge level of interviewed respondents. Lowest knowledge was recorded for poor category where 2.92% were having less chrotogonous familiarity. Likewise, maximum percentage 28.75 was recorded of good followed by 28.33% satisfactory knowledge for cutworm. Lowest percentage 11.75 was recorded of excellent knowledge of respondents for cutworm. Moreover, highest percentage 33.33 was recorded of fair followed by 32.92% of poor knowledge for hairy caterpillar. Lowest observed value (7.92%) was of excellent knowledge level. Similarly, maximum (31.67%) were recorded of satisfactory knowledge level for vertebrate pets. Second highest percentage (26.25) was recorded of fair knowledge. Likewise, minimum 8.33% respondents were having poor knowledge of vertebrate pets. Similarly, highest (27.08%) was recorded of respondents having good knowledge for Cercospora personata. Second highest (23.75%) was of satisfactory knowledge of interviewed farming community. Lowest percentage 5.42 was observed of respondents having poor knowledge of Cercospora personata. While, possessed mean (3.08) indicate satisfactory to good level of knowledge about vertebrate pests. Possessed mean (3.51) indicate that higher trend was from satisfactory to excellent level about Cercospora personate, whereas, required

familiarity (1.46) for termite management very little efforts are required to enhance respondent's knowledge.

Similarly, required mean (1.75) for depicted poor and fair knowledge are needed to be improved for better control of chrotogonous. Whereas, required knowledge mean (1.95) for cutworms management was of poor and fair categories. Required mean (2.69) exhibit much efforts need to be done from satisfactory to good knowledge level to reduce losses through hairy caterpillar similarly, required mean (1.91) for vertebrate pest management exhibit poor to fair familiarity index. Required mean (1.48) shows poor knowledge level about Cercospora personata that needs attention to improve existing situation. Respondent's awareness about insect and pest mainly depends on education of rural farming community. Farmers having educated children were recorded to be aware of threats regarding insects and pests. Extension department should take steps towards training against various insect/pests, their mode of action and timely control to avoid losses. Farmers knowledge was assessed by Bellon (2001: 32) and he further believed lack of knowledge faced by them even to identify a specific insect.

Different chemicals to control major disease of groundnut were observed and presented in Table 1. New chemistries were recorded to be unknown mostly among respondents. Out of total surveyed farmers maximum 22.50% were having satisfactory knowledge of bifenthrin. However, fair and excellent knowledge of farming community was statistically at par with each other (20.83, 20.00%) respectively. Lowest knowledge was assessed for poor category (19.17%). Similarly, maximum (65.83%) respondents were having poor knowledge of permethrin, 3kg +10kg ash, whereas, lowest value was recorded of excellent (2.08%) knowledge. Likewise, highest respondent's knowledge was assessed of poor category for using carbrgle 5kg+ash or permethrin. Whereas, minimum calculated percentage (5.42) knowledge was of excellent pool. Moreover, maximum (60.00%) respondents were having poor knowledge of using light-trap or pyrethroid spray per cyno gas or bait to control groundnut pests. Moreover, minimum (5.42%) farming community was having excellent familiarity of this modern pest control method. Possessed mean (2.98) for use of bifenthrin indicate that respondent's knowledge was between fair and satisfactory categories. Possessed mean (1.67) reveals highest concentrated knowledge in poor to fair category for the use of permethrin, 3kg +10kg ash. Possessed mean (1.68) reveals that mostly respondents interest was of poor to fair knowledge carbaryl 5kg+ash or permethrin.

Additionally, possessed mean (1.89) exhibit that mostly farmers were having poor knowledge.

Results revealed that required mean (2.01) depicted more efforts are needed to educate farmers for the use of bifenthrin. Required mean (3.32) indicates that much effort from satisfactory to good knowledge level should be made to aware farming community for the use of permethrin, 3kg +10kg ash. Required means (3.31) indicate that efforts should be made for the improvement of farmer's knowledge for using carbaryl 5kg+ash or permethrin. Whereas, required mean (3.10) which indicate that much efforts are need to enhance farmer's knowledge.

Other than chemical control of diseases there are number of methods such as cultivation of disease resistant genotypes, tillage practices to control seed borne diseases, biological control agents and fungicide application at right time are worldwide tested approaches. Farmer's education and training for necessary and specific diseases by extension personals can boost groundnut yields. Jallow et al. (2017: 340-345) concluded that higher insecticide knowledge of farming community against various insect pests provide good yield returns as compare to illiterate personals. Groundnut is

associated to be susceptible to various types of diseases which cause huge economic losses. Yield losses ranged from 10-70 percent from all over the world due to different diseases has been reported in number of studies. Different climatic conditions favor various disease epidemics. Variety selection is important criterion to cope with yield losses due to diseases.

Data presented in Table 1 indicated that maximum (26.25%) of respondents were having excellent knowledge for Cercodpora personata, whereas, poor and good farming community knowledge was statistically similar (20.83, 21.25%). Similarly, highest 55.42% farming community was having excellent and second highest (31.25%) of fair knowledge level, whereas, 3.75% was lowest calculated value of respondents having excellent knowledge. Maximum (56.67%) of farming community was having satisfactory knowledge level of Aspergilis niger. Whereas, minimum (2.08%) each was recorded of excellent and good respondent's knowledge. Moreover, maximum (57.92%) respondents were having satisfactory knowledge. Likewise, minimum 2.92% was recorded of excellent group respondents of Fusarium sp. Verticillium alboatstrum, Rhizoctonia soloni. Possessed mean (3.15) indicates satisfactory to excellent knowledge trend about disease Cercodpora personate. Possessed mean (2.65) for Collectotrichum demmatra explain higher farmers trend towards fair and satisfactory level. Mean possessed value (2.60) indicate more farmers trend for satisfactory and fair level for Aspergilis niger. Required mean (1.84) for Cercodpora personata reveals that more work need to be done for poor and fair knowledge categories. Moreover, required mean (2.34) depict that more hard work need to be done between to enhance farmers knowledge for Collectotrichum demmatra to minimize groundnut losses and required level (2.39) reveals that fair to satisfactory knowledge are to be improved for Aspergilis niger. However, possessed mean (2.67) reveals higher trend between fair and satisfactory knowledge level. Whereas required mean (2.32) indicate that more efforts from fair to satisfactory level are need to be done for improvement of farmers' knowledge for the control of Rhizoctonia soloni.

Farmers training regarding various diseases at different crop stages in necessary to cope adverse effects of these diseases. Disease epidemic depends on climatic factors as more humidity favors and whole crop becomes affected in days. Significant variation for identification and cure of various disease was observed by Abang et al. (2014: 240-253).

Seed treatment to control various diseases is of prime importance. Untreated seed are more prone to soil and seed borne diseases. Various formulations are available in the market now-a-days for seed treatment. Seed treatment not only protects seeds against diseases but also provides even germination and crop stand.

During field surveys, it was assessed that maximum 29.58% respondents were having poor knowledge of application of Topsin M 2kg/kg seed treatment, whereas, fair and excellent knowledge was statistically similar (17.92). Maximum (30.00%) respondents were having fair knowledge of using Benlate 2kg/kg as seed treatment. Second highest calculated value was 25.42% of poor knowledge. Lowest recorded value was 12.92% of excellent knowledge. Similarly, highest 81.67% respondents were having poor knowledge of seed borne disease control through crop rotation. Lowest calculated percentage was (0.42%) of excellent knowledge that means small number of farmers were well aware of this modern technique. Possessed value (2.80) indicates higher knowledge about application of Topsin M 2kg/kg seed treatment trends were between fair to satisfactory levels. Mean possessed value (2.59) for Benlate2kg/kg as seed treatment depicted that existing knowledge level is between fair and satisfactory level but more tilted toward satisfactory level of knowledge. Possessed mean (1.31) indicate present

knowledge about controlling disease with rotation of crops is more concentrated in poor category. While, required mean (2.19) revealed fair type of knowledge is needed to enhance farmer's knowledge. Whereas, required mean (2.40) reveal training is needed to enhance farmer's knowledge of using Benlate 2kg/kg as seed treatment. Whereas, required mean (3.68) reveals that up to good level of training is needed to boost the existing position.

Latest technology of controlling disease with rotation of crops is another way of controlling disease epidemics. Data revealed that mostly respondents were unaware of controlling diseases with crop rotation. Farming communities in developing countries used their own knowledge for controlling prevailing diseases, although their knowledge is limited and most of the time not effective was reported by Adam et al. (2015: 97-107).

## Conclusion

It was concluded that middle age farmers having ownership of land are usually more leaned towards learning so it might be easy to train growers of groundnut. Growers have low level of knowledge about use of storage at dry places and control measures of insect pest and diseases. It was concluded that there was more need of training in case of storage after harvesting, control of pest and diseases. It was also concluded that campaign might be launched to educate the farmers in sectors were they had low level of knowledge.

## References

Abang, A., Kouamé. C., Abang, M., Hanna, R., Fotso, A. (2014). Assessing vegetable farmer knowledge of diseases and insect pests of vegetable and management practices under tropical conditions. International Journal of Vegetable Science, 20(3), 240-253. http://dx.doi.org/10.1080/19315260.2013.800625

Adam, R.I., Sindi, K., Badstue, L. (2015). Farmers' knowledge, perceptions and management of diseases affecting sweet potatoes in the Lake Victoria Zone region, Tanzania. Crop Protection, 72 (2), 97-107. https://doi.org/10.1016/j.cropro.2015.02.010

Ahmad, N., Davide, J., and Saleem, M. (1988). Fertility status of soils in dry land areas of Pakistan. Paper presented at the Proceedings of international seminar on dry land agriculture in Pakistan.

Anaeto, F.C., Asiabaka, C.C., Nnadi, F.N., Ajaero, J.O., Aja, O.O., Ugwoke, F.O. (2012). The role of extension officers and extension services in the development of agriculture in Nigeria. Wudpecker Journal of Agricultural Research, 1(6), 180-185.

Bellon, M.R. (2001). Participatory research methods for technology evaluation: A manual for scientists working with farmers. Mexico, D.F.: CIMMYT. Available at: https://repository.cimmyt.org/xmlui/bitstream/handle/10883/1023/74275.pdf

Diagne, A., Demont, M. (2007). Taking a new look at empirical models of adoption: Average treatment effect estimation of adoption rates and their determinants. Agricultural Economics, 37(2-3), 201-210. https://doi.org/10.1111/j.1574-0862.2007.00266.x

Farinde, A.J., Ajayi, A.O. (2005). Training needs of women farmers in livestock production: implications for rural development in Oyo State of Nigeria. Journal of Social Sciences, 10(3), 159-164. https://doi.org/10.1080/09718923.2005.11892475

Foster, A.D., Rosenzweig, M.R. (1995). Learning by doing and learning from others: Human capital and technical change in agriculture. Journal of Political Economy, 103(6), 1176-1209.

GOP. (2016). Statistics. Government of Punjab. Pakistan.

GOP. (2008). Economic Survey of Pakistan. Economic Advisor's Wing. Islamabad, Pakistan.

Hulme, D. (1992). Training for development, (2nd ed.) by Rolf P. Lynton and Udai Pareek. West Hartford, Kumarian Press Journal of International Development, 4(3), 333-337.

Jallow, M.F., Awadh, D.G., Albaho, M.S., Devi V.Y., Thomas B.M. (2017). Pesticide knowledge and safety practices among farm workers in Kuwait: results of a survey. International Journal of Environmental Research and Public Health, 14(4), 340-345. https://doi.org/10.3390/ijerph14040340

Madhusudhana, B. (2013). A Survey on area, production and productivity of groundnut crop in India. Journal of Economics and Finance, 1(1), 01-07.

Maraddi, G., Meti, S., Tulasiram, J. (2014). Extent of adoption of improved technologies by groundnut farmers and constraints analysis. Karnataka Journal of Agricultural Sciences, 27(2), 177-180. https://doi.org/10.9790/5933-0130107

Nourse, H.C. (1973). Cultivation of peas in South austria. Extension Bulletin, 3, 11-13.

Ntare, B.R., Waliyar, F., Ramouch, M., Ndjeunga, J. (2004). Market Prospects for Groundnut in West Africa. Common Fund for Commodities. Technical Paper No.39. Available at: http://www.icrisat.org/PDF/757.pdf

Pattee, H.E., Pearson, J.L., Young, C.T., Giesbrecht, F.G. (1982). Changes in roasted peanut flavor and other quality factors, with seed size and storage times. Journal of Food Science, 47, 455-456.

Prased, P.V.V., Craufurd, P.Q., Summerfield, R.J. (2001). Response of groundnuts dependent on symbiotic and inorganic nitrogen to high air and soil temperatures. Journal of Plant Nutrition, 24(4-5), 623-637. Available at: http://www-personal.k-state.edu/~vara/prasad-pvv-jpn01.pdf

Rehman, F. (2010). Development of a strategy to enhance the role of print media in the dissemination of agricultural information among farmers' in Punjab Pakistan. Islamabad.

Sokoya, A.A., Alabi, A.O., Fagbola, B.O. (2014). Farmer information literacy and awareness towards agricultural produce and food security: FADAMA III programs in Osun state Nigeria. Available at: http://library.ifla.org/1001/1/140-sokoya-en.pdf

Weiss, T.G. (2000). Governance, good governance and global governance: conceptual and actual challenges. Third World Quarterly, 21(5), 795-814. Available at: www.jstor.org/stable/3993619