

Groundnut Research in Konkan: A New Look

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Abstract

Groundnut (*Arachis hypogaea* L.) or peanut is unpredictable legume and recently attracted attention as functional food in Konkan. Konkan region is predominated by rice crop and it has rich agro-ecological diversity and, therefore, groundnut is ideally suited in such conditions. The suitable package of practices developed by Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli for groundnut crop in Konkan have the highest groundnut productivity (1800 kg ha⁻¹) over national productivity during rabi. The different package of practices with suitable varieties for groundnut in different zones of India also recorded higher yields. In konkan region rice-groundnut is one of the profitable cropping systems with higher economic returns. The success stories of different groundnut growing farmers imply they have higher yield with TKG Bold variety with recommended package of practices, which showed there is massive scope for increasing groundnut crop in Konkan.

Keywords: Groundnut, Konkan, package of practices, yield.

Introduction

Cultivated groundnut (*Arachis hypogaea* L.) or peanut is a self-pollinated annual legume crop, widely grown for its high quality edible oil and food use in the tropical and warm temperate regions of the world. The nine oilseeds namely groundnut, rapeseed-mustard, soybean,

sunflower, safflower, sesame, niger, castor and linseed, accounted for an area of 23.44 million hectares with the production of 25.14 million tonnes (Kalamkar 2006). Groundnut is grown in more than 100 countries and major groundnut producers are China, India, Nigeria, USA, Senegal, Myanmar, Indonesia and the Sudan (undivided) (Anonymous 2015).

India is the second largest groundnut producing nation in the world with an annual production of 5.64 million tonnes pods after China (15.71 million tonnes pods). Groundnut is important cash crop and is low-priced commodity but has valuable source of all the nutrients. About 7.5 million hectares are put under it annually and the production is about six million tonnes. Out of total area and productivity, 70 % area and 75 % of the production have been concentrated in the five states namely Gujarat, Andhra Pradesh, Tamil Nadu, Karnataka and Maharashtra (Patel & Agarwal, 1993). In Maharashtra, kharif groundnut production was 2.57 lakh tonnes from 2.52 lakh hectare with productivity of 1080 kg ha⁻¹. However, in rabi total production was 1.25 lakh tonnes from 0.82 lakh hectare with 1521 kg ha⁻¹ productivity (Anonymous 2015). In Konkan region groundnut is grown on 20,000 ha area with 1800 kg ha⁻¹ productivity. The groundnut crop is new in this region. However, the area under roundnut in Konkan has increased enormously. The upland early duration rice varieties are being replaced with groundnut cultivation due to poor yield in rice. The groundnut area is increasing fast during rabi season in command areas of different dams and rivers in Konkan region. The potash rich porous soil coupled with optimum temperature and humidity favors higher pod yield in groundnut which is double as compared to upghat region or the rest of Maharashtra. The Konkan strip having so many tourist spots provide heavy scope for hand-picked and selected

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(HPS) grade groundnut kernels.

Some predominant groundnut growing states, seasons and growing conditions are narrated in Table 1.

Agro-ecological Regions of Groundnut Farming in India

Groundnut is adapted to varying agroclimatic conditions and soils. About 75 % of the groundnut area lies in a low to moderate rainfall zone with a short period of distribution. In India it is primarily grown in rainy *kharif* season (June/July to September/October) under rainfed conditions, which accounts for 83% of the total area under this crop in the country. The remaining 17% of the area is cultivated mostly in the post-rainy *rabi*/summer season (October/November to March/April) with irrigation or on residual soil moisture. Though

management practices of the crop have improved in recent years and the declining trend in yield has been arrested, however, there are wide fluctuations in yield due to rainfall and soil factors. Taking into consideration the above factors, the groundnut cultivation has been demarcated into five zones based on soil factors, rainfall pattern, diseases and pest situations. A brief account of the various zones with climate and crop weather conditions, soil and rainfall pattern is presented in Table 2.

Groundnut production practices

There are different packages of practices recommended by respective states and compiled in Table 3.

Groundnut Varieties Grown in India

The new generation high yielding varieties developed

Table 1. Details of groundnut growing situations

Season	Condition	States
Kharif	Rainfed	Andhra Pradesh, Gujarat, Karnataka, Maharashtra, Rajasthan, Tamil Nadu, Uttar Pradesh
Rabi	Residual irrigation / minimum irrigation	Andhra Pradesh, Karnataka, Odisha, Tamil Nadu, West Bengal
Summer	Irrigated crop	Gujarat, Karnataka, Maharashtra
Spring	Irrigated	Punjab

Table 2. Zone wise climate and crop weather conditions with soil and rainfall pattern in India

Zones	States	Temperature		RH (%)	Characteristic features
		Min	Max		
I - Northern zone	Uttar Pradesh, Punjab, Haryana, Rajasthan	12	38	57 – 88	Sandy loam to loamy sandy soil; 600-900 mm rainfall per crop season
II - Western zone	Gujarat, Southern Rajasthan	19	35	76 – 94	Medium to black soil/ sandy loam; 500-700 mm rainfall per crop season
III - Central zone	Madhya Pradesh, Maharashtra	16	37	65 – 90	Medium black soil - sandy loam; 700-900 mm rainfall per crop season
IV - South-Eastern zone	Bihar, West Bengal, Orissa, Coastal Andhra Pradesh	14	34	78 – 92	Red loam - sandy loam; 900-1300 mm rainfall per crop season
V - Peninsular zone/ Southern zone	Karnataka, Andhra Pradesh, Southern Maharashtra, Tamil Nadu, Kerala	15	31	68 – 95	Medium black to red loam/ sandy loam; 600-1300 mm rainfall per crop season

Table 3. Zone wise Package of practices for Groundnut cultivation (I - Northern Zone, II - Western Zone, III - Central zone,

Zone	Cultivar	Plant Spacing & Seed rate	Sowing time	Sowing method
I	Rajasthan: Spanish bunch (ICGS-1, RG 425, RG 382, RG 141) Virginia Runner (RG 382, HNG 10, Girnar 2, HNG 69)- N-W Rajasthan Haryana/UP: Virginia runner	Spreading: 45-60 x 20 cm Runner 90 x 20 cm Spreading: 80 -100 kg ha ⁻¹	Rajasthan: From last week of June to mid July Punjab: 20 June to 10 July UP: Second week of June to first week of July	Sowing should be done about 5 cm deep behind the plough or with the help of dibbler or seed planter.
II	Gujarat: Virginia Runner (Somnath, TMV-3, TMV-4, TMV-6, TMV-8, TMV-10) Spanish: (Junagadh-II, GAUG-1, Junagadh-113, GAUG-2, TMV-2, TMV-7, TMV-9) S. Rajasthan: Virginia bunch (GG 20)	Bunch 30-40 x 15 cm Spreading: 45-60 x 20 cm Erect/bunch: 80 - 100 kg ha ⁻¹ Spreading : 60 -80 kg ha ⁻¹	15 June to 1 July	Sowing should be done about 5 cm deep behind the plough or with the help of dibbler or seed planter.
III	N. Maharashtra: Spanish bunch (TAG-24)- Grown in Khandesh, Vidharbha, and part of Marathwada. Virginia Runner in Osmanabad and Beed districts. MP: Spanish Bunch (Jyothi Ganga-puri)	Spanish bunch: 30x10 150 kg ha ⁻¹	Last week of June to first week of July	Sowing should be done about 5 cm deep behind the plough or with the help of dibbler or seed planter.
IV	Orissa: Virginia bunch (BAU13, BG3) West Bengal Spanish bunch (GG 2)	10-15 x 30-45 cm 100-160 kg ha ⁻¹	Last week of June to first week of July	Use of seed drill (bullock-drawn or tractor-mounted)
V	Konkan Kharif: Virginia bunch Rabi- Spanish/Virginia AP: Virginia Runner (Kadri-771-1, Kadri 3) common in Rayalseema while some area accounts Spanish and Virginia Bunch (Kadri-2) ; Spanish bunch (ICGV 86590)-Telangana state Karnataka: Spanish and Virginia Runner (S-26, DH 3-30, and S-230) TN: Spanish (TMV-2, TMV-9 and TMN-12)	Spreading: 45 x 15 cm / 45 x 10 cm Semi Spreading: 30 x 50 cm Erect: 30 x 10 cm Erect/bunch: 125 - 130 kg ha ⁻¹ Semi spreading : 100 -110 kg ha ⁻¹ Spreading: 80 - 100 kg ha ⁻¹ AP: 120-140 kg ha ⁻¹	AP(Telengana) & Coastal region: Mid June to first week of July. Rabi- November to January Karnataka: Bunch - 1st week of June and Spreading - last week of June to July end Rabi- Last week of December to January TN: In Coimbatore- April & in rest area during 1 st Fortnight of July Rabi- 1 st week of Jan.	Konkan- Sowing behind the plough and dibbling Karnataka/AP/ Kerala/TN- Dibbling, Sowing should be done about 5 cm deep behind the plough or with the help of dibbler or seed planter.

IV - South - Eastern Zone, V - Peninsular zone /Southern zone; R- Rainfed, I: Irrigated)

Seed treatment	Fertilizer management	Irrigation	Weed control	Duration
3 gm Thiram or Mencozeb 2 gm kg ⁻¹ seed to control collar rot, <i>Rhizobium</i> culture @ 25 gm kg ⁻¹ seed	Rainfed/Irrigated: 20:60:0 kg ha ⁻¹ Gypsum: 250 -500 kg ha ⁻¹ Two sprays of thiourea solution @ 0.1% or TGA @ 100 ppm at flowering and pod filling stages	Sprinkler irrigation is suitable Irrigation interval is 7-8 days	Hand weeding twice, at 20 DAS and second 35 DAS or Pre-emergence herbicides, Pendimethalin @ 1.0 -1.5 kg a. i. ha ⁻¹ as spray or Fluchloralin @ 1.0 -1.5 kg a. i. ha ⁻¹ as pre-plant soil incorporation followed by 1-2 hand weeding	120 – 150
3 gm Thiram or Mencozeb 2 gm kg ⁻¹	R:12.5-25:50-60:0 kg ha ⁻¹ I: 25-37.5:50-70:0 kg ha ⁻¹	<i>Rabi</i> : 3-4 irrigations. 1 st at flowering and subsequent during fruiting to encourage peg penetration and pod development.	Pre-emergence herbicides, Pendimethalin @ 1.0 -1.5 kg a. i. ha ⁻¹ as spray or Fluchloralin @ 1.0 -1.5 kg a. i. ha ⁻¹ as pre-plant soil incorporation followed by 1-2 hand weeding	115 – 130
Seed treatment with Thiram @ 2 gm kg ⁻¹ seed and <i>Rhizobium</i> culture @ 25 gm kg ⁻¹ seed	Irrigated: 20:40:00 kg ha ⁻¹	<i>Kharif</i> - Rainfed <i>Rabi</i> /summer- 750-900 mm water. Irrigation interval is 8-12 days	Pre-emergence herbicides, Pendimethalin @ 1.0 -1.5 kg a.i. ha ⁻¹ as spray or Fluchloralin @ 1.0 -1.5 kg a.i. ha ⁻¹ as pre-plant soil incorporation followed by 1-2 hand weeding	100 – 110
Seed treatment with Thiram @ 2 gm kg ⁻¹ seed and <i>Rhizobium</i> culture @ 25 gm kg ⁻¹ seed	Orrisa : FYM/Compost 10-12 t ha N:8-20 kg ha ⁻¹ , P ₂ O ₅ :16-80 kg ha ⁻¹ , K ₂ O:0-75 kg ha ⁻¹ Gypsum 200-400 kg ha ⁻¹ B:3-4 kg ha ⁻¹ ; Z:10-20 kg ha ⁻¹	<i>Kharif</i> - Rainfed <i>Rabi</i> /summer- 600-650 mm water. Sprinkler irrigation is preferred	Pre-emergence herbicides, Pendimethalin @ 1.0 -1.5 kg a.i. ha ⁻¹ as spray or Fluchloralin @ 1.0 -1.5 kg a.i. ha ⁻¹ as pre-plant soil incorporation followed by 1-2 hand weeding	110 – 120
Seed treatment with Thiram @ 2 gm kg ⁻¹ seed and <i>Rhizobium</i> culture @ 25 gm kg ⁻¹ seed	Konkan : FYM@ 10 t ha or 5 t ha vermicompost; Fertilizer: 25:50:00 kg NPK ha, 20 kg ZnSO ₄ 100% RDF (25 kg N + 50 kg P ₂ O ₅) at sowing and 50% RDF (12.5 kg N + 25 kg P ₂ O ₅) as top dressing at 30 DAS AP: R: 20:40:20 kg ha ⁻¹ I: 30:40:25 kg ha ⁻¹ Karnataka : R: 15:30:25 kg ha ⁻¹ I: 25:75:25 kg ha ⁻¹ Tamil Nadu : R: 11:22:33 kg ha ⁻¹ I: 22:44:66 kg ha ⁻¹	<i>Kharif</i> - Rainfed <i>Rabi</i> - Pre sowing irrigation and after this irrigations at 15 days internal up to flowering stage and then irrigation at 10 to 12 days interval up to pod development stage.	Pre sowing herbicides Fluchloralin @ 1.0 kg a.i. ha ⁻¹ or pre emergence application of Butachlor @ 1.5 kg a. i. ha ⁻¹ or Oxadiargyl @ 0.12 kg a.i. ha ⁻¹ at 2 to 3 DAS and one hand weeding at 30 DAS For effective weed, pre emergence application of Pendimethalin @ 1 kg ha ⁻¹ combined with one hand weeding at 30-35 DAS is recommended. If hand weeding is not possible, pre emergence application of Pendimethalin @ 1 kg ha ⁻¹ be combined with post emergence application of either Quizalofopethyl @ 50 g ha ⁻¹ or Imazethapyr @ 75 g ha ⁻¹	95 – 120

Table 4. Groundnut varieties recommended and grown in India

Zones	Recommended Area	Varieties
I	Rajasthan, Punjab, Haryana, Uttar Pradesh	ICGS-1, HNG-10, Girnar-2, TG37 A, Prakash Amber, Utkarsh, GG-14, GG-21, Raj Mungphali-1, SG99 M-548, HNG-10, GG-14, GG-21, HNG-69, HNG -123 Prakash, Amber, Utkarsh, HNG-1, Girnar-2
II	Gujarat, Western Rajasthan, Madhya Pradesh	Somnath, GG-2, GG-20, TG-37 A, GG-5, GG-6, GG-7, JL501, GJG-9, GJG-31, TPG41, DH-86, GJG-17, GJG-22 JGN-3, JGN-23, AK-159, GG-8
III	Maharashtra, Madhya Pradesh	SB-XI, Kopargaon-1, AK-159, JL-220, JL-286, JL-501, AK303, Ak-365, Ratneshwer, TLG-45, TAG-24, DH-86, Kadiri Harithandra
IV	Orissa, Bihar, Coastal Andhra, Pradesh, West Bengal	OG 52-1, ICGV-91114, Girnar-3, TAG-24 Kadiri-6, Narayani, ICGV-91114, Kadiri-9, GPBD-4, Abhaya, Prasuna, Greeshma, Ajeya, Vijetha, Kadiri Harithandra, ICGV-00350, Kadiri-7, Kadiri-8 Girnar-3, TAG-24, TG 37A, TG-51, Dh-86
V	Southern Maharashtra, Andhra Pradesh, Tamil Nadu, Karnataka	TKG-Bold and Konkan Gaurav, VRI-2, VRI (Gn)-6, TMV (Gn)-13, Co (Gn)-5, Co-6, ALR-2, VRI (Gn)-7, GPBD-4, ICGV 00348, ICGV 00350 GPBD-4, TGLPS-3, Ajeya, Vijetha, VRI (Gn)-6, ICGV-91114, TAG-24, Kadiri Harithandra

and released for different zones are presented in Table 4.

Groundnut varieties recommended for Maharashtra

About 60 % of the groundnut area in Maharashtra is under Spanish bunch varieties, which is confined to the northern parts of the state in the regions of Khandesh, Vidarbha, and parts of Marathwada where groundnut crop is sown in month of January and harvested by end of May. Development of Spanish bunch varieties with early maturity (because of the short monsoon rain) and tolerant to drought and rust is specially required for this region. In the Marathwada region, Osmanabad and Beed districts Virginia Runner type varieties are grown in *kharif* with red gram, sorghum or sunflower because these two districts get rains from both Southwest and Northeast monsoons. In parts of Ahmednagar, Pune and Solapur districts, the crop is sown in March/April and harvested in August. In Jayakwadi command area (Aurangabad and Beed districts) only Virginia Runner

varieties are preferred and crop rotation of groundnut (March-October) and wheat (November-February) is practiced. In Konkan region during *kharif* season Virginia runner type while in *rabi* and summer season both Spanish bunch and Virginia bunch cultivars are grown. In Maharashtra, SB-XI, Kopargaon-1, AK-159, JL-220, JL-286, JL-501, AK303, Ak-365, Ratneshwer, TLG-45, TAG-24, DH-86, Kadiri Harithandra, TKG-Bold and Konkan Gaurav groundnut varieties are commonly grown.

Groundnut Cultivation practices in Konkan region of Maharashtra

Climate

For groundnut favorable temperature range is 21-27°C during crop growth period. However, minimum temperature below 18°C at sowing and excess of 35°C reduce germination and flower initiation. Average

rainfall of about 700-1000 mm is useful to the crop. The konkan region is characterized with high altitude and humid, sub-humid as well as dry temperature. It has high rainfall (3000-3500 mm), mostly influenced by Southwest monsoon with 80% precipitation in June-September months. The low temperature during middle of crop growth might reduce the growth and yield during rabi season. However, polythene mulch technology offsets the low temperature effect and has shown the potential for rabi groundnut in Konkan. Among the 9 Agroclimatic zones of Maharashtra, South Konkan coastal zone, North Konkan coastal zone and parts of Western Ghats zone come under Konkan region.

Soil properties

North Konkan zone consists of Raigad, Thane and Palghar districts. The soil is coarse in texture with yellowish red to medium black in colour and 7.5-12.5 cm soil depth with high water holding capacity. These soils show high organic matter (2-3%) and organic carbon (1.5-3.0%), with medium pH i.e. 4.5-6.5 and electric conductivity of 0.23 dS m⁻¹. So all these condition favor groundnut cultivation.

Ratnagiri and Sindhudurg districts come under South Konkan zone. These soils are lateritic, sandy loam to clay loam in texture, reddish in colour due to dominated kaolinite mineral with 7.5-15 cm soil depth. These soils are with high organic matter (2-3%) and organic carbon (0.7-1.50%), acidic in reaction with soil pH 4.41 and electric conductivity 0.038 dS m⁻¹. The red lateritic soils having low pH can be kept under control by use of soil amelioration. These soils are porous, have low moisture retention capacity and provide ambient conditions for growth and development of groundnut. As soils are porous, excessive irrigation and drainage is not problem in this type of soil.

Suitable varieties/cultivars

During *kharif* season, Virginia type groundnut cultivars are grown as they have fresh seed dormancy. However, in *rabi* and summer season both Spanish bunch and Virginia bunch groundnut cultivars are grown. The runner type being longer in duration and sensitive to high temperature are not suitable to grow during both

conditions in Konkan and also as it may not set good number of pods and may get overlapped with rain during harvest in *rabi*.

The Konkan Gaurav and Trombay Konkan Groundnut (TKG-Bold) are two groundnut varieties recommended for cultivation in Konkan. Konkan Gaurav is semi spreading type. Crop matures in 105-120 days in *kharif* and 120-130 days in *rabi*. It is suitable for both the seasons as it has fresh seed dormancy of 30 days. It has 75-77 % shelling out-turn and 49 % oil content. Its yield potential is about 18-20 q ha⁻¹. It is developed by DBSKKV, Dapoli in 1990. While, Trombay Konkan Groundnut is semi spreading and bold variety, matures 115-120 days and is suitable for rabi season. It also has fresh seed dormancy of 25-30 days with high protein percent and is suitable for table purpose. It has 68-70% shelling out -turn and 47-49% oil content. Its yield potential is about 20-22 q ha⁻¹ and developed in collaboration with BARC, New Mumbai and DBSKKV, Dapoli in 1993.

Seed rate, spacing and sowing

Medium tillage practice followed by harrowing is very useful for groundnut cultivation. Before last harrowing Farm Yard Manure @ 10 t ha⁻¹ or Vermicompost @ 5 t ha⁻¹ incorporated into the soil and soil is leveled. For higher yield, pure and certified seed is recommended. Seed rate vary for variety i.e. for bold varieties it is 120-125 kg ha⁻¹, for medium bold 100 kg ha⁻¹ seed and for small seed size it is 80-100 kg ha⁻¹. Seed treatment with carbendazim/Captan @ 2.5 g kg⁻¹ of seed or thirum 5 g kg⁻¹ seed before sowing to control wilt or other seed borne disease at initial crop growth stage. For healthy crop growth and easy availability of nutrients from chemical fertilizers, seed is treated with Symbiotic Nitrogen fixers like, Rhizobium or Phosphorus Solubilizing Bacteria (PSB) @ 25 g kg⁻¹ of seed. Rhizobium treatment increases number of nodules on root and enhance rate of atmospheric Nitrogen fixation and yield upto 10-15%. While, PSB seed treatment solubilize soil phosphorus and make available to plants.

Optimum sowing time

Kharif groundnut is sown in the first fortnight of June

after monsoon showers. While, in part of Sindhudurg district it is done after rice planting i.e. in the month of July. If sowing is delayed after 15th July, reduction in yield is observed. In *rabi*, groundnut is also sown from 15th November to 15th December while in summer from 15th January to 15th February. Due to low disease pressure and more sunshine hours, *rabi* and summer crops produce 1.5 to 2.0 times more yield than the *kharif* crop.

Sowing methods:

Majority of farmers follow groundnut sowing on flat bed in konkan. However sowing on flat bed reduces the groundnut yield because Virginia bunch varieties are semi spreading and most of pegs remain on top soil which affects pod development. Traditionally, farmers sow groundnut behind the wooden/country plough with 30-45 cm row distance. In this method plant to plant distance is not maintained and yield reduction due to insufficient plant stand. Hence, the improved methods of groundnut cultivation like Broad Bed and Furrow (BBF) and polythene mulching technology are given by DBSKKV, Dapoli.

Broad Bed and Furrow or ICRISAT method: This method is developed by International Crop Research Institute for Semi Arid Tropics, Hyderabad (ICRISAT) and very suitable for konkan region due to high rainfall zone. In this method beds of 1.2 m width and 15-20 cm height with suitable length (depending on slope) are prepared. In *kharif* season beds formed towards the land slope while in *rabi* opposite to the land slope is recommended. The distance between two beds is 30 cm. Groundnut is sown in 5 rows on each bed with 30 cm row spacing while plant to plant 10 cm distance is maintained. This method requires normal seed rate of 120-125 kg ha⁻¹. The main advantages of BBF include drain off excess water, easy for intercultural operation and soil on bed always remains loose and porous which facilities higher root mass and root nodules with more atmospheric N fixation.

Polythene mulching Technology: Nowadays polythene mulching technology is new emerging technology in Konkan region particularly in *rabi* season. In *rabi*

season, soil temperature below 18°C hampers seed germination in such case polythene mulching is desirable which increases the soil surface temperature about 5-6°C and also reduces crop growth period (8-10 days) and ensures that water will be available to entire crop growth period, as water availability is problem in some areas after month of April. The bed is formed with 90 cm base width, 60 cm top width and 8-10 cm height. The distance between two beds is kept 30 cm. Plastic film having 5-7 micron thickness is used for mulching which facilitates easy peg penetration in to soil through film. About 55 kg white transparent polythene mulch having 90-100 cm width is required for one hectare mulching. Before mulching the holes of 3-4 cm are prepared by zigzag means with keeping of 20 cm row space and 10 cm for plant spacing. Likewise, each bed consist 3 rows (20 cm) of groundnut with 10 cm plant spacing. Also, prior to groundnut sowing under polythene mulching all recommended fertilizer dose and weed management practices are followed to keep weeds under control. Two groundnut seeds are placed in each hole, therefore this method required nearly double seed rate i.e. 200-220 kg ha⁻¹. Mulching prevents direct soil moisture evaporation and limits water losses by conserving moisture which reduces 2-3 irrigations. It acts as barrier to soil pathogens and nematodes, suppress weed and develop a microclimate underside of the sheet with increased microbial activity desirable for groundnut. The pegs arrived at later stage are weak and unable to penetrate plastic film hence, better pods with synchronous maturity and increased oil and protein percent with yield. Polythene mulch technique is new way to get higher returns, and DBSKKV, Dapoli recommended to grow *kharif* groundnut on BBF at 80 - 20 cm using 7 micron 44 kg ha⁻¹ transparent polythene mulch for higher yield and economic returns. (Released recommendation 2013).

Earthing up operation:

In most parts of Konkan, groundnut cultivation is done on flat bed which results in poor yield. The main reason is semi spreading groundnut varieties have lateral pegging and all pegs do not enter soil and are unable to produce pods. Therefore, to avoid this loss, earthing

up operation is necessary on flat bed sowing. Earthing up is carried out by 'Swastik implement' developed by DBSKKV, Dapoli. It is done at 30 days after sowing and after 15 days drum-rolling is performed so that most of the lateral pegs go into the soil. The groundnut grown on BBF does not require earthing up operation.

Fertilizer and nutrient management

The recommended fertilizer dose for groundnut cultivation in konkan is 25:50:00 kg NPK ha⁻¹. However, groundnut meets its 60-80 % Nitrogen requirement from symbiotic nitrogen fixation by root nodules and only 20-40 % by soil nitrogen. Therefore, Nitrogen supply to groundnut has played crucial role and its deficiency is observed between 10-45 DAE and at pod formation stage. So that, 25 kg Nitrogen be applied through external sources, the half at the start of the cultivation as basal and half at pod filling as booster (top dressing) dose. The Spanish and Virginia bunch groundnut, has lesser crop duration and nitrogen fixation response, therefore more addition of external nitrogen than the Virginia runner.

Also, majority of farmers apply whole quantity of fertilizers at sowing which reduces the fertilizer use efficiency. Experiments conducted at ARS, Shirgaon showed that split application of nitrogen in groundnut resulted in significant effect on pod yield of groundnut. Therefore, 100% RDF (25 kg N + 50 kg P₂O₅) at the time of sowing and 50% RDF (12.5 kg N + 25 kg P₂O₅) as top dressing at 30 DAS is recommended for profitable groundnut yield. (Released recommendation 2013). The phosphorus requirement is high in groundnut which promotes plant growth, enhances pod filling, shelling percentage and crop yield. The recommended phosphorus to groundnut is 50 kg ha⁻¹ and total quantity is applied as basal dose in konkan. Moreover, higher availability of soil potassium (K₂O) does not need its soil application.

Red lateritic soils are acidic and deficient in micronutrients, particularly, B and Mo deficiency while, Fe and Mn availability at toxic levels are observed. Deficiency of B causes hollow heart of kernel in which inner faces of cotyledons are depressed and discolored

reducing the quality of groundnut seed with half pod filling and less shelling. Hence, soil application of 1 kg B ha⁻¹ and 20 kg Zn through ZnSO₄ is advisable to correct the B and Zn deficiency. However, experiments conducted at ARS, Shirgaon showed that application of 20 kg ZnSO₄ ha⁻¹ along with recommended dose of fertilizer (25 kg N + 50 kg P₂O₅) gave higher pod yield in konkan region (Yadav *et al.* 1982)

Weed management

Severe problem of weed infestation occurs in Konkan region during *khariif* season due to heavy rainfall. However, comparably less weed flora observed in *rabi* season. The monocot weeds are *Digitaria sanguinalis*, *Echinochloa crusgalli*, *Oryza sativa*, *Cynodon dactylon*, *Cyperus defformis* and *Eleusine indica* are dominating in Konkan except *Cynodon dactylon*. However, in dicot weed *Cleome viscosa*, *Convolvulus arvensis*, *Leucas aspera*, *Amaranthus* spp., *Eclipta prostrata*, *Alternanthera sessilis*, *Euphorbia hirta* and *Physalis minima* are dominated except *Cleome viscosa*, *Convolvulus arvensis* in Konkan.

The weeds are more competitive in removing plant nutrients from the soil, twice as much N, 24% more K and twice more Ca than groundnut plants, and thus, deprive the crop from optimum nutrient uptake and increase the total nutrient requirement of groundnut crop. The critical period of weed competition in groundnut varies with soil, climate, crop cultivar and weed species and has been reported from 4 to 8 weeks (Priya *et al.* 2013, Dayal 1998). Virginia cultivars reduce weed growth more than Spanish cultivars, and in Spanish cultivars the critical period was found to be 35 DAS, whereas, in Virginia cultivars it was 45-60 DAS (Tiwari *et al.* 1989). Intercropping systems reduce weed competition period as compared to sole groundnut. In groundnut + pigeon pea intercropping, the critical period of weed competition was between 2 and 8 weeks (Released Recommendation 2013). In general, the maximum period of weed competition that can be tolerated by groundnut crop without any adverse effect on yield is around 30 DAS.

For weed control in groundnut, first hoeing at 15 days

after sowing is followed by two subsequent hoeing at 15 days intervals with 1-2 weeding keeping crop weed-free upto 30 days after sowing. Under some circumstances like rain or others, if these practice is not followed then, experiments at ARS, Shirgaon recommended that pre emergence application of Pendimethalin @ 1 kg ha⁻¹ combined with one hand-weeding at 30-35 days after sowing. If hand-weeding is not possible, pre emergence application of Pendimethalin @ 1 kg ha⁻¹ be combined with post emergence application of either Quizalofopethyl @ 50 g ha⁻¹ or Imazethapyr @ 75 g ha⁻¹ are used for effective and profitable weed control. Also, under resource constraints, give first preference to fertilizer management followed by weed management and plant protection measures, respectively for obtaining higher productivity and profit from *kharif* groundnut (Released Recommended 2014 & Released Recommended 2016).

Cropping system

Some remunerative inter-cropping systems for different states have been recommended to increase the income obtainable per unit area and time. Groundnut based inter-cropping systems were evolved for different agroclimatic zones to minimize the risk factors associated with rainfed cultivation. In konkan region, it is recommended to apply 25 kg N + 75 kg P₂O₅ ha⁻¹ to groundnut and 75% RDF (75 kg N + 37.50 kg P₂O₅ + 37.50 kg K₂O ha⁻¹) to rice for getting higher yield and economic returns from *rabi* groundnut-*kharif* rice system.

Irrigation

The red lateritic soils are dominated by kaolinitic clay minerals which have low cation exchange capacity and low moisture retention capacity. They are also very porous with good drainage and better permeability to water and air. On account of low moisture retention capacity they require small amount of irrigation at short intervals.

Konkan region is high rainfall zone and *kharif* groundnut is completely rainfed but, *rabi* season requires 70-80 cm irrigation water for successful cultivation. The flood irrigation method has low water use efficiency (40-45%), ridges and furrow (60-70%) while, sprinkler irrigation

gave 65-85% water use efficiency which also save 35% water with increased yield upto 25%.

Amount of water applied to critical growth stages is also very important. If sufficient water is not available at critical growth stages there is drastic yield reduction. For groundnut branching to 50% flowering (35-50 days) and 50% flowering to pod development (50-70 days) are critical growth stages and if sufficient water not available pod remains small and reduced seed size and ultimately affect yield. Depending on soil type and crop growth period irrigation interval is also managed. Crop growth period in February-March has 10-12 days interval and April-May-June is 8-10 days. However, medium to heavy soils of North Konkan require 10-12 days interval while, red lateritic light soils of south Konkan zone require 7-8 days of irrigation interval.

Pest and Disease management

a) Insect and pests:

The aphids, jassids and thrips are sucking pests while leaf minor, leaf eating caterpillar, white grub and termites are major pests in Konkan. These can be controlled by proper remedial measures as, spray Dimethoate 30 EC @ 500 ml or Monochrotophos 36SL @ 700 ml or Methyl demeton 25 EC or Cypermethrine 20 EC 200 ml 500 ml or quinalphos 25 EC @ 750 ml or 50% WS Carbaryl powder @ 2kg in 500 lit ha⁻¹. Soil drenching of quinalphos 5 lit or phorate 10G or carbofuron 3G 25 kg ha⁻¹ is preferred for white grub and termite control.

b) Diseases:

Tikka, rust, bud necrosis and root rot are major diseases observed in Konkan region in groundnut cultivation. For control of diseases, seed treatment with Thirum 5 g ha⁻¹ or 2.5 g kg⁻¹ of seed and spraying at flowering and each 15 days interval for two times with Mancozeb 25 g or Carbendazim 10 g or Propiconazol 10 ml liter⁻¹ or sulphur 25 g or 5 ml Tridemorf lit⁻¹⁰ water is followed. *Aspergillus flavus* causes post-harvest fungal disease, Aflatoxin which grows inside the groundnut seed. Aflatoxin contaminated seed are shriveled covered by yellow or greenish spores, unsuitable for eating. To avoid aflatoxin contamination, during harvesting less/no

breakage of pods or broken pods processed separately, pods are sun dried for 5-6 days and stored in dry place in perforated bags without water contact.

Harvesting and storage

As groundnut is an indeterminate crop, hence synchronous maturity of its pods can not be obtained. Therefore, harvesting should be done when 75-80% of pods are mature. The important indications of maturity are yellowing leaves, necrotic spotting on leaves, dropping of old leaves, pods become very hard and tough, they give cracking sound when split open with fingers, the inside of the shell turning dark, with netted venation, seed coat develops pink or red colour (normal color of the varieties) is observed.

Generally harvesting is done by pulling or lifting the plants from the soil with pods intact. If soil moisture is adequate, then hand pulling is practiced. If soil is dry, tractor or bullock drawn blades are used for lifting the vines with pods. Harvesting before maturity reduces yield and oil percentage and seeds are highly susceptible to aflatoxin. If delayed, results in increased incidence of stem rot. The most common method is stripping pods with hand, but it is tedious and time consuming and labour intensive method. However mechanical stripping of pods saves manpower and time also.

At the time of harvest, pods usually have moisture content around 40–50% and need to be dried upto 10% moisture content for safe storage. Sun drying is the usual method of drying. Pods for seed purpose are stored in earthen pots, mud bins or bamboo baskets or Gunny bags having polythene lining. If the seed moisture content is above the critical level of 9-10%, then aflatoxin is produced due to *A. flavus*.

Success stories of groundnut farmers in konkan

Success stories of some groundnut growing farmers in Konkan region those who have been getting bumper pod yield by adapting packages of practices given by DBSKKV, Dapoli.

1. Shri. Vijay Narayan Pandit

Shri. Vijay Narayan Pandit of village Nanij, Ratnagiri

was one of the beneficiary farmer of the FLD conducted during *rabi* 2012-13. He was a marginal farmer having land of 0.60 ha for seasonal crops. Before the sowing of FLDs, the farmer's training was conducted for providing guidelines regarding implementation of groundnut FLDs. Total 30 kg seed of improved variety 'Trombay Konkan Tapora' was supplied to him for an area of 0.20 ha. along with check variety SB XI on same area. He conducted the demonstration under supervision of the scientists of the Agricultural Research Station, Shirgaon. He applied total 12 irrigations to the demonstration plot from farm well using electric lifting pump facility available at his farm. Other intercultural operations viz., weeding, earthing up, fertilizer application and plant protection measures were adapted by him on right time as per the guidelines from the scientists of the station to both the plots of demonstration.

At the time of harvesting, he got 3035 kg ha⁻¹ pod yield and 3197 kg ha⁻¹ haulm yield from improved variety of groundnut TKG Bold as against 2886 kg ha⁻¹ pod yield and 2841 kg ha⁻¹ haulm yield from the local check. He got the highest pod yield (2886 kg ha⁻¹) of local check variety SB XI among the selected farmers under the programme during *rabi* 2012-13 which was 24.3 % higher than the average pod yield (2322 kg ha⁻¹) of SB XI under the FLD programme.

It was 17.5 per cent higher net returns from the improved variety (₹ 58476 ha⁻¹) over the local check (₹ 49747 ha⁻¹) with B:C ratio 1.78 from improved variety and 1.70 from local check. He was satisfied by the yield obtained from his demonstration plot. The effect of this demonstration was positive. Though the groundnut crop is new for this region, neighbouring farmers were inspired by the success of FLD plot of Shri. Pandit.

2. Shri. Mahesh Keshav Narvekar

Shri. Mahesh Keshav Narvekar of village Kotawade, Ratnagiri was one of the beneficiary farmer of the FLD conducted during *rabi* 2012-13. He was a marginal farmer having land of 0.60 ha for seasonal crops. Before the sowing of FLDs, the farmer's training was conducted for providing guidelines regarding implementation of groundnut FLDs. Total 30 kg seed of improved variety

'Trombay Konkan Tapura' was supplied to him for an area of 0.20 ha. He conducted the demonstration under supervision of the scientists of the Agricultural Research Station, Shirgaon. All the package of practices recommended by the University was followed by him. He applied total 12 irrigations to the demonstration plot from farm well using electric lifting pump facility available at his farm. Other intercultural operations viz., weeding, earthing up, fertilizer application and plant protection measures were adapted by him on right time as per the guidelines from the scientists of the station and he became one of the successful farmer in this programme.

At the time of harvesting, he got 3342 kg ha⁻¹ pod yield and 3712 kg ha⁻¹ haulm yield from improved variety of groundnut TKG Bold as against 2835 kg ha⁻¹ pod yield and 2774 kg ha⁻¹ haulm yield from the local check. It was 49.6 per cent higher net returns from the improved variety (₹ 66967 ha⁻¹) over the local check (₹ 44763 ha⁻¹) with B:C ratio 1.83 from improved variety and 1.60 from local check.

He was satisfied by the yield obtained from his demonstration plot. The effect of this demonstration was positive. Though the groundnut crop is new for this region, neighbouring farmers were inspired by the success of FLD plot of Shri. Narvekar.

3. Shri. Sriram Narayan Phadake

Shri. Sriram Narayan Phadake of village Purnagad, Ratnagiri was one of the beneficiary farmer of the FLD conducted during *kharif* 2013. He was a marginal farmer having land of 0.60 ha for seasonal crops. Before the sowing of FLDs, the farmer's training was conducted for providing guidelines regarding implementation of groundnut FLDs. Total 30 kg seed of improved variety 'Trombay Konkan Tapura' was supplied him for an area of 0.20 ha. He conducted the demonstration under supervision of the scientist of the Agricultural Research Station, Shirgaon. All the package of practices recommended by the University was followed by him. Other intercultural operations viz., weeding, earthing up, fertilizer application and plant protection measures were adapted by him on right time as per the guidelines

from the scientists of the station and he became one of the successful farmer in this programme.

At the time of harvesting, he got 3725 kg ha⁻¹ pod yield and 4800 kg ha⁻¹ haulm yield from improved variety of groundnut TKG Bold as against 3325 kg ha⁻¹ pod yield and 3800 kg ha⁻¹ haulm yield from the local check. It was 49.8 per cent higher net returns from the improved variety (₹ 75982 ha⁻¹) over the local check (₹ 50720 ha⁻¹) with B:C ratio 1.92 from improved variety and 1.71 from local check.

He was satisfied by the yield obtained from his demonstration plot. The effect of this demonstration was positive. Though the groundnut crop is new for this region, Ratnagiri farmers were inspired by the success of FLD plot of Shri. Phadake.

4. Shri. Mangesh Purshotam Kadam

Shri. Mangesh Purshotam Kadam, of village Khambale, Vaibhavwadi, Sindhudurg was one of the beneficiary farmer of the FLD conducted during *kharif* 2015. He was a marginal farmer having land of 0.60 ha for seasonal crops. Before the sowing of FLDs, the farmer's training was conducted for providing guidelines regarding implementation of groundnut FLDs. Total 36 kg seed of improved variety 'Trombay Konkan Tapura' was supplied him for an area of 0.24 ha. He conducted the demonstration under supervision of the scientist of the Agricultural Research Station, Shirgaon. All the package of practices recommended by the University was followed by him. Other intercultural operations viz., weeding, earthing up, fertilizer application and plant protection measures were adapted by him on right time as per the guidelines from the scientists of the station and he became one of the successful farmer in this programme.

At the time of harvesting, he got 2450 kg ha⁻¹ pod yield and 2725 kg ha⁻¹ haulm yield from improved variety of groundnut TKG Bold as against 1800 kg ha⁻¹ pod yield and 2200 kg ha⁻¹ haulm yield from the local check. It was 78.2 per cent higher net returns from the improved variety (₹ 62762 ha⁻¹) over the local check (₹ 35616 ha⁻¹) with B:C ratio 2.56 from improved variety and 1.86 from local check.

He was satisfied by the yield obtained from his demonstration plot. The effect of this demonstration was positive. Though the groundnut crop is new for this region, Sindudurga farmers were inspired by the success of FLD plot of Shri. Mangesh Purshotam Kadam.

Summary

Groundnut is successfully cultivated in Konkan region. The use of packages of practices recommended by DBSKKV, Dapoli showed positive effect on groundnut yield. Though it is emerging crop for Konkan compared to rest of Maharashtra, it is gaining popularity. Nowadays rice – groundnut is one of the profitable cropping system in Konkan region with higher economic returns. Success story of different groundnut growing farmers viz., Shri. Pandit, Narvekar, Phadake and Kadam recorded highest yield with TKG Bold variety by adoption of recommended package of practices given by DBSKKV, Dapoli.

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