Peanut farmers' experience with FARMSCAPE in Peninsular India

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Abstract

Researchers and extension officers collaborated with farmers in addressing peanut cropping and sowing decisions using on-farm experiments and cropping systems simulation in the Pollachi region of Tamil Nadu, India. The most influential variable affecting the peanut productivity in this irrigated region regard sowing date. During the 1998-1999 rabi (post rainy) season, three farmers fields in villages in Pollachi region were selected and monitored. The APSIM model was used to simulate the effect of sowing date. The APSIM-Peanut module simulation demonstrated close correspondence with the field observation in predicting yield. The model predicted that December sowing resulted in higher yield than January sowing due to longer pod filling period, and this was confirmed by farmer experience. The farmers and extension officers became comfortable with their role as owners of the collaborative experiments and custodians of the learning environment.

Media Summary

Use of FARMSCAPE simulation approach was tested in Peninsular India with farmers for making decision on sowing date for peanuts.

Key words

Extension, decision support, sowing date, participatory research

Introduction

Peanut (*Arachis hypogea*) is an important source of oil and protein in the daily diets of the people in Peninsular India. Average groundnut yields are as low as 0.90 t/ha although yields of 2 to 2.5 t/ha have been obtained in the peanut growing region (Gibbons, 1977). Though the dependence on rainfall is an important factor contributing to poor yields, management practices, including time of sowing, choice of cultivar and fertilizer use often cause low yields. The demand for peanuts is increasing, but the area under peanut cultivation is limited. To meet the increased demand, there is need to increase the productivity per unit area. The normal practice has been for researchers to train extension staff to advise farmers to follow improved management options through occasional visits to farms or through radio broadcasts. Often these efforts fail to convince farmers because the extension package does not meet their actual needs.

Traditionally farmers try to grow peanuts throughout the year. Most farmers sre unaware of the importance of sowing date in realising climatic potential yield. Research station trials had produced very little information to offer better agronomic recommendations. Use of FARMSCAPE (Farmers, Advisors, and Researchers, Monitoring, Simulation, Communication and Performance Evaluation) research approach (McCown et al. 1998, Carberry et al. 2002) was tried for the first time in India with collaboration from ICRISAT and APSRU (Australian Farming Systems Research Unit). The approach in FARMSCAPE is to apply scientific knowledge to real world management scenarios thorugh computer simulation models, to inform practitioners on better managing the systems (McCown et al. 1998). The extension staff and farmers in Peninsular India are not familiar with computerised decision support systems. After observing the initial success with the approach in Australia, through ICRISAT/APSRU as partners of this research project in 1998, a collaborative research activity was initiated with a pilot group of peanut-growing farmers

and their extension advisors in the Pollachi region of Tamil Nadu, Peninsular India. The plan was to explore sowing date options in on-farm trials and to test the applicability through simulation in their management systems. The objectives of this paper are to examine the results from the on-farm monitoring of sowing date and cultivar choice effect, to test the ability of APSIM-Peanut module to simulate these results, and to report on what was gained through this approach.

Materials and Methods

During the 1998-99 rabi (post rainy) season we contacted peanut growing farmers in villages close to Aliyarnagar agricultural research station (AARS), and agricultural extension officers in Pollachi region, seeking collaboration. Three farmers agreed to become involved from villages Reddiyarur, Angalakurichi and Avalchinnampalayam (10.34^{o}N, 77.00^{o}E, Alt 260 m). The other members of the collaborating team comprised three agricultural extension officers and four researchers. All the farmers volunteered at least half of the portion of a field with intention that they would carry out the experiments of interest to the broader farmers group and researchers. All the required inputs (seed, fertilizer and pesticide) for the experimental part was provided by AARS. The entire experimental field was irrigated through the canal ayacut irrigation system. The proposed experiments included sowing date treatments.

Anticipating that crops might soon be sown, sampling by the researchers was done in selected farmers' fields on 15 December 1998, to establish the initial state of soil water and mineral N. There was a strong similarity in the general physical properties of the soil being cropped on these farmers' fields. All the sites fitted the description: sandy loam, which is well-drained and moderately permeable (Typic Rhodustalfs). Two soil cores of 44 mm diameter, reaching to the full depth of the potential root zone of the crop, were taken from all the farmers' field locations to estimate the field capacity and wilting point by means of the pressure plate method. Daily temperature and rainfall were measured using an automatic weather station at one farm. Peanut cultivar TMV2 was hand planted in the experimental portion of the field. The field was prepared in a system of beds and channels 300 m long and 12-15 m wide. The row spacing was 30 cm and plant spacing was 10 cm, which gave a plant population of 33 plants per m^2. Fertilizer was applied at the rate of 17 kg N/ha as urea, 34 kg P/ha as single superphosphate and 54 kg K/ha as KCl. Gypsum (Ca_2SO_4) at 500 kg/ha was side-dressed at flowering stage. Immediately after sowing, all plots were irrigated to bring the soil to field capacity. The crop was intensively protected from diseases and pests, and was harvested at maturity.

Crop phenology at reproductive growth stages (flowering, beginning seed growth and maturity) were recorded for all experiments. Four times during crop growth plant samples were taken from 1 m^2 in three locations in each farmer's field, and plant components were separated to determine leaf area and division of dry matter into various plant components. Soil moisture was determined gravimetrically. Core samples were taken at the same time as growth analysis, up to a rooting depth (90-120 cm) at 15 cm depth intervals. Crop biomass and pod yields were recorded in three portions in each farmer's field at harvest. Area harvested in plot ranged from 50-100 m^2. Dry weight of haulms, pod and seeds were determined by oven-drying either the whole harvest or a sub-sample of it. To measure the accuracy of the model observed and simulated RMSD values were calculated.

Results

APSIM-Peanut model parameterisation

The model used to simulate the experiments was the peanut module of APSIM 1.61 (McCown et al. 1996). The APSIM-Peanut model was evaluated against the crop growth and phenology and soil moisture data of the research station rabi 1997 (post rainy) season experiments. The soil profile characterisation (research farm) and genetic coefficients (TMV2) were determined and unchanged for evaluating the model for the on-farm simulation. Using 1977-97 weather data, a long-term simulation crop growth and yields was performed for a range of possible sowing dates between October and February for the TMV2 peanut cultivar. The prediction was that changing the sowing date to mid-December would increase groundnut yields considerably, an increase of about 900-1000 kg/ha would be expected (data not

presented). The APSIM-peanut model appeared to be capture the cool versus warm season phenomena quite well during the different sowing periods.

On-farm simulation

In general, air temperature (maximum and minimum) increased throughout the growing period (Fig.1). In all the villages, days to flowering, pod initiation and maturity were predicted by the model within ?3- 4 days. Reddiyarur peanut cultivar TMV2 flowered 37 days after sowing, which was 2 days earlier than Angalakurichi and Avalchinnampalayam. Dates to flowering, seed and maturity were satisfactorily predicted by the APSIM-Peanut model (Table1). The pod-filling duration was greater than 66 days which is usually considered favourable for achieving the potential yield of peanut crop. The close prediction of the reproductive stages of the model for the farmers' fields indicates that the temperature and photoperiod used to predict the reproductive phenology were satisfactory, as has been observed elsewhere (Singh et al. 1994).

Crop biomass and pod yields

The APSIM-Peanut model predicted yield response to planting date for the rabi 1998-99 (post rainy) on-farm experiments presented in Table1. The high peanut pod yield recorded in Avalchinnampalayam may be related to soil fertility. The pod yields recorded at Reddiyarur and Angalakurichi were similar. The crop biomass recorded in all on-farm experiments were similar. The peanut cultivar TMV2 gave uniform total biomass despite the variation in pod yield across villages because of its harvest index superiority. All three sowing dates recorded pod yield over 2500 kg/ha. December sown crop had a favourable photoperiod up to pod filling and better partitioning to pods and seeds, which is highly desirable for realising high yields (Duncan et al. 1978). The model predicted the pod and total biomass closer to the observed yields in all three on-farm experiments.

Figure1. Mean daily air temperatures during 1998-99 rabi (post rainy) season at Pollachi region

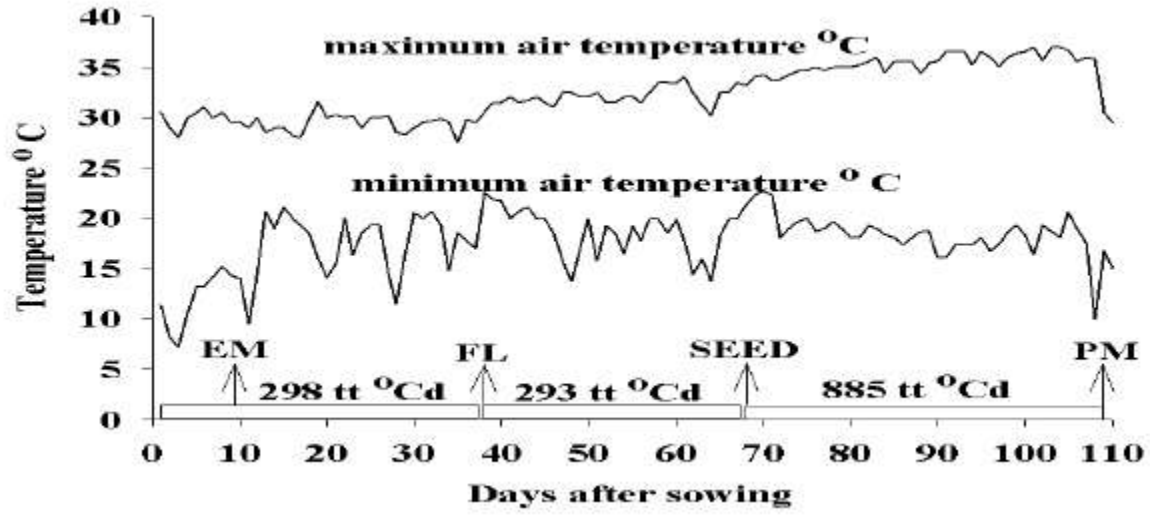

Table 1. Experimental conditions observed and APSIM-Peanut model predicted phenology, pod yield and crop biomass for TMV 2 in three villages (Reddiyarur, Angalkurichi and Avalchinnampalayam) Pollachi region of Tamil Nadu, Peninsular India during the rabi 1998-99 post rainy season.

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Location of on farm experiment	Sowing Date	Flowering DAS		Seed DAS		Maturity DAS		Pod yield (kg/ha)		Crop biomass (kg/ha)	
		Obs	Sim	Obs	Sim	Obs	Sim	Obs	Sim	Obs	Sim
Reddiyarur	20 Dec	37	35	66	64	110	112	2593	2666	4750	5218
Angalakurichi	21 Dec	37	37	66	66	109	112	2567	2700	4819	4950
Avalchinnam palayam	20 Dec	41	39	68	65	110	115	3695	3757	4000	4018
RMSD		1.6		2.1		2.7		94.6		280.7	

Discussion

The researchers, extension officers and participating farmers were all engaged for the first time in truly joint planning and management of field experiments. Each learned from the experience. Learnings encompassed expanded knowledge of the peanut crop management system in Pollachi region of Tamil Nadu, Peninsular India, and the emergence of modified land management practices. A key outcome from this activity was learning about how the participatory research process operates. This first time experience fostered subsequent government funding for input management for further participatory approach.

Use of a simulation approach to predict peanut yield for sowing date was new for the researchers, extension officers and farmers. Farmers had been under the impression that peanuts can be grown at any time during the season. However, computer simulation and on-farm trials reported in this paper demonstrated that temperature plays a key role in pod-filling duration, which is a sowing decision which allows farmers to realize the climatic potential yield of peanut at Pollachi. From these on-farm experiments on sowing date, the researchers had the opportunity to learn how well APSIM-Peanut performed in simulating results from large scale on-farm experimentation. As it turned out, the sowing decision trials provided the opportunity to test APSIM-Peanut model simulation when dealing with simple decision making process of peanut cropping in a remote region. This paper adds to this cumulative experience by demonstrating that APSIM, appropriately parameterised, was able to adequately simulate sowing date effects on crop growth and yield in farmers fields in the post rainy season in Peninsular India.

Conclusion

This first implementation of participatory action research in Pollachi region of Tamil Nadu meant that farmers no longer had to adopt new crops and technologies with which they had little experience. Computer simulation of crops can now be used to help farmers to identify strategies to make best use of scarce water resources, and in this case to avoid low temperature and high temperature stress during pod filling period. Computer modelling can substitute for a significant part of experimentation. By using the model while in close contact with the farmers, extension officers and researchers were able to gauge the reliability of the model. When the model accurately simulated the yield of the farmer’s crop, farmers became interested in using the model to explore other scenarios. Our experience working with peanut growing farmers in the Pollachi region was expanded by comparing sowing dates and cultivar choice.

The first important step was to make observations on farmer’s field-monitoring of soil water, nitrogen, crop growth and yield. This comprehensive collection of high quality data provided information for testing the

model, and also attracted the interest of farmers in making field observations that they had not previously done. In terms of knowledge of the system, there were major revelations, especially about the examination of the question of whether to sow the peanut crop in December or January. The model predicted that December sowing resulted in higher yield than January sowing. The model prediction was then confirmed by the farmers who now expect to obtain greater yields than previously. Use of computer simulation has been a rewarding experience for farmers, researchers and extensionsts. Now, the approach is being extended to larger areas.

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