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Promotion of Integrated Disease Management for ICGV 91114, a dual-purpose, early maturing groundnut variety for rainfed areas

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International Crops Research Institute for the Semi-Arid Tropics

Promotion of Integrated Disease Management for ICGV 91114, a dual-purpose, early maturing groundnut variety for rainfed areas

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Contents

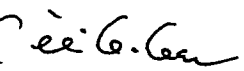
Preface

Groundnut (*Arachis hypogaea* L.) is one of the most important oil seed crops in the rainfed areas of the Deccan Plateau in India. It also provides nutritious fodder for ruminants. For several decades, the farmers of this region have cultivated the traditional cultivar TMV 2, which suffers from several diseases, resulting in low quantity and quality of pod and fodder yields. Of these diseases, two foliar diseases, late leaf spot (*Phaeoisariopsis personata*) and rust (*Puccinia arachidis*), are economically significant.

ICRISAT, in collaboration with partner organizations, has been working for the past decade to develop and promote sustainable management technology options to manage these foliar diseases and in turn to achieve higher yields of pod and fodder at the farm level. Moreover, farmers in this region need a high yielding, improved cultivar with appropriate production technology to replace TMV 2. After several on-station and on-farm studies, a dual purpose, early-maturing groundnut cultivar ICGV 91114 and its Integrated Disease Management (IDM) technology were developed at ICRISAT. In addition to the cultivar, the package includes economical use of fungicide as seed treatment and foliar application.

This bulletin provides information about the management-responsive, early-maturing cultivar ICGV 91114 and its IDM technology. It also traces its genesis, evaluation and eventually, promotion through the farmers' participatory approach. The potential economic benefits of the use of the cultivar and its impact on groundnut-growing areas of the Deccan Plateau are also outlined. It is now clear that the dual-purpose cultivar ICGV 91114 can successfully replace the local cultivar TMV 2.

The authors have put in tremendos effort and must be congratulated for their success in promoting IDM technology for ICGV 91114 to benefit groundnut farmers in the Deccan Plateau.



William D Dar
Director General
ICRISAT

The context

Groundnut (*Arcachis hypogaea* L.) is a major oilseed crop and is cultivated in 8 million ha in India with a production of 7.5 million tons (FAO 2003). The crop provides high quality edible oil for human consumption and nutritious fodder for ruminants. It also provides easily digestible proteins, half of 13 essential vitamins and seven of 20 essential minerals necessary for normal body growth in humans.

In India, groundnut is grown in three seasons, rainy (85% area), postrainy (10% area) and summer (5% area). Among the states, Gujarat and Andhra Pradesh (AP) are the largest producers of groundnut in the country, and together occupy 55% of total area and production. Karnataka, Tamil Nadu and Maharashtra are the other groundnut growing states in the country (Fig. 1).

In Andhra Pradesh, the crop is grown in about 2.1 million hectares every year, one-third of which is in Anantapur district alone; in fact, Anantapur is the single largest groundnut-growing district in the world (Fig. 2).

Within the district (Fig. 3), groundnut accounts for 67% of area followed by sorghum (8%), paddy (4%) orchards (18%) and other horticulture crops (3%).

Apart from the income from groundnut pods, farmers also use haulms as feed for dairy animals and sale of milk is an important additional source of income. Significantly, several farmers buy paddy straw or sorghum

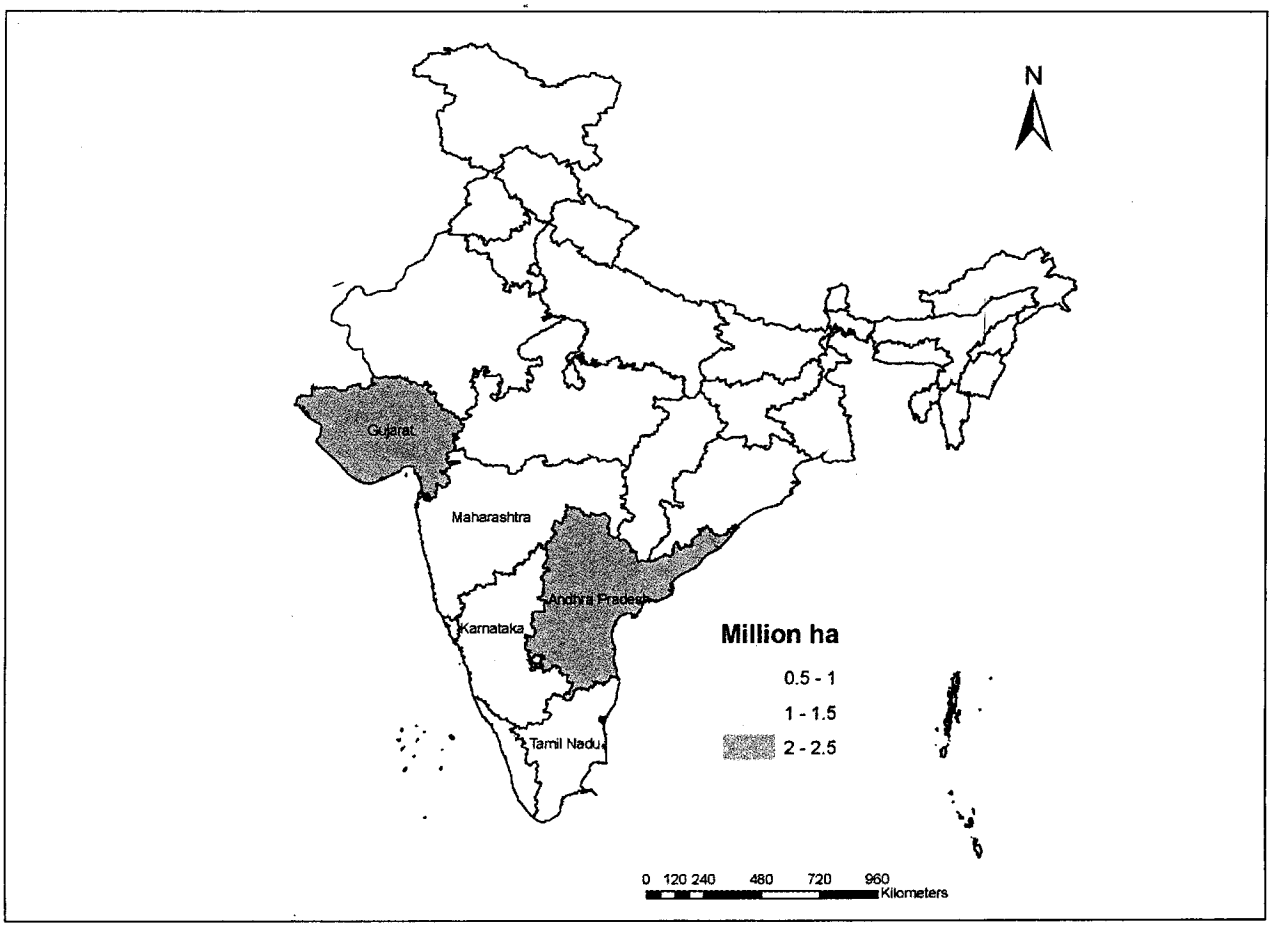


Fig. 1. Major groundnut growing states in India.

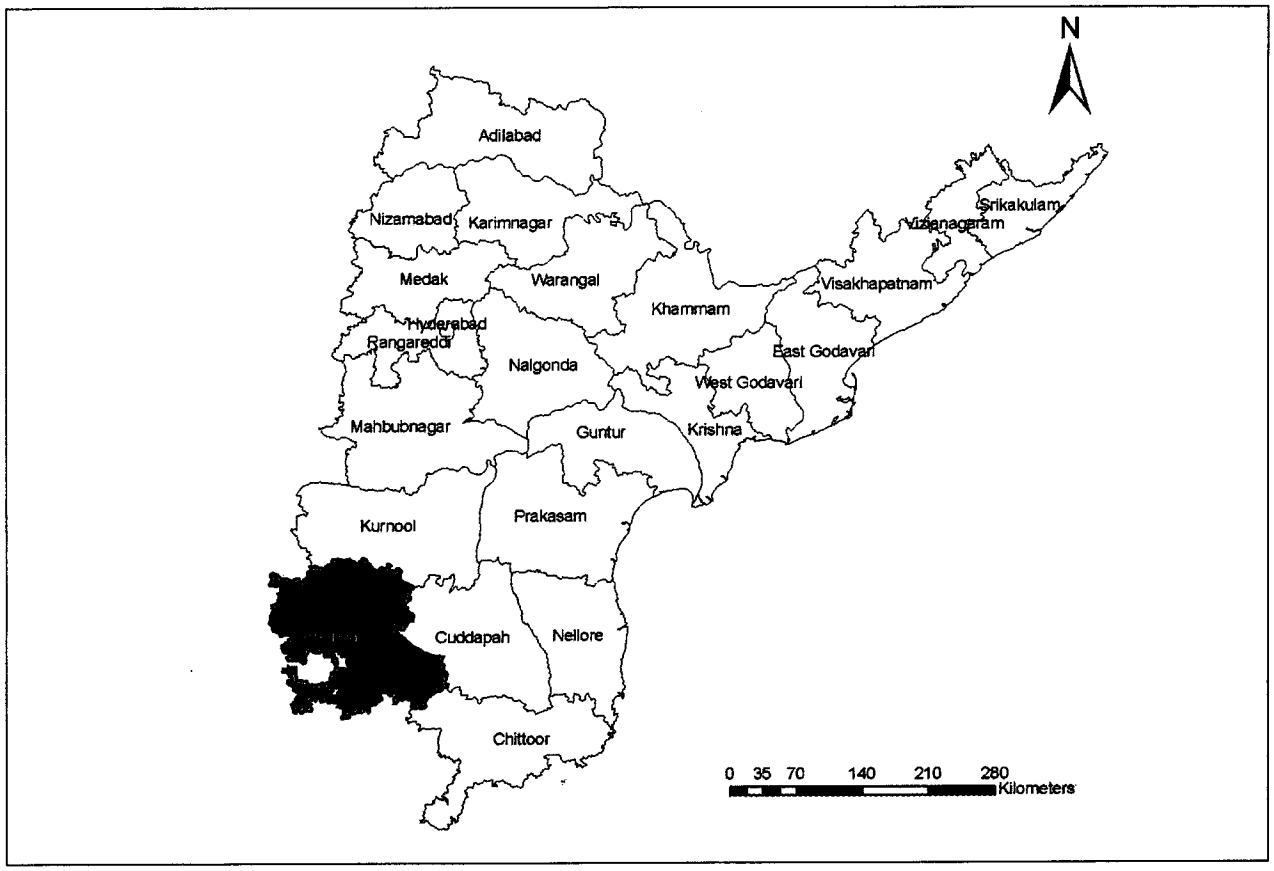


Fig. 2. Anantapur, the largest groundnut growing district in the world.

stover from other states since the available groundnut haulm is insufficient to meet fodder requirements in the region.

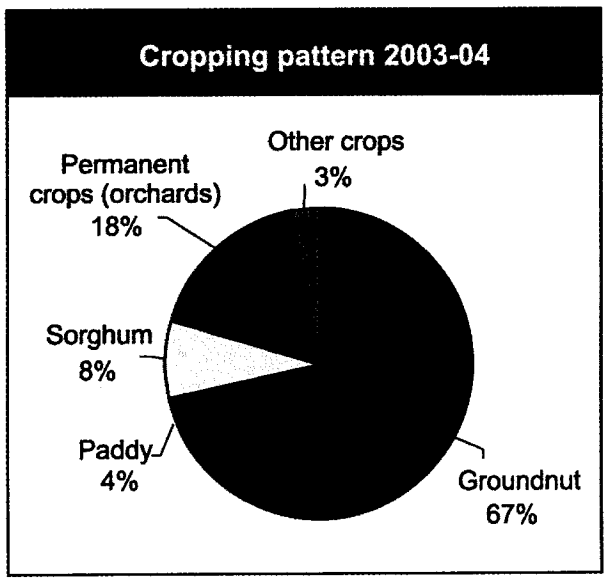


Fig. 3. The cropping pattern in Anantapur, 2003-2004.

Groundnut productivity in India is very low: less than 1 t/ha compared to 2.25 t/ha in the USA (FAO 2003). Yields in Anantapur are still lower ie, 0.5 t/ha. Only in Gujarat, in the Saurashtra region, are yields close to 1.4 t/ha. Several reasons contribute to low yields in India, particularly in the rainfed areas of the Deccan Plateau:

- Non-availability of seeds of improved cultivars and their production technology
- Lack of awareness on diseases, insect pests and their management
- Scanty, erratic and unpredictable rainfall, and
- Socioeconomic conditions of dryland farmers.

Although several improved cultivars have been released in the Deccan Plateau since the 1980s, their adoption has not been widespread. These varieties lacked traits acceptable to

farmers, were susceptible to diseases and insect pests, and also suffered price discrimination by traders in local markets. In this region, farmers generally favor short (90-100 days) and medium duration (100-115 days) cultivars over long duration cultivars (120 days and above) (Table 1). Presently, the dominant cultivar that occupies about 80% of the total area in the rainfed districts of the Deccan Plateau is TMV 2, followed by JL 24 (10%), Vemana (K 134) and others (10%) (Fig. 4).

Table 1. Popular groundnut cultivars, their duration and productivity under rainfed conditions in the Deccan Plateau, India.

Cultivar	Duration (days)	Productivity kg/ha
TMV 2	105-110	480-600
JL 24	105-110	600-720
Vemana	105-110	720-1040
Polachi (red)	110-115	700-850

Source: DAATTC, Anantapur.

Unfortunately, all these cultivars are susceptible to several fungal diseases in farmers' fields. Of these, late leaf spot (LLS) (*Phaeoisariopsis personata*) and rust (*Puccinia arachidis*) are the most destructive foliar diseases (Fig. 5) and together cause up to 70%

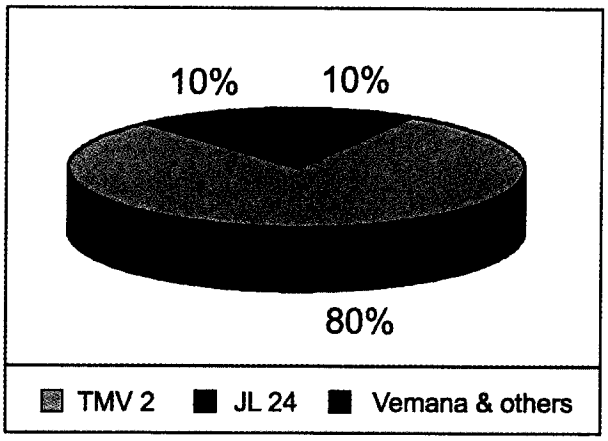


Fig. 4. Percentage distribution of popular groundnut cultivars in the Deccan Plateau.

losses in quantity and quality of pods and haulms (Gorbet et al. 1990; Pande et al. 2001). Foliar diseases and thereby infected fodder affect the health of livestock. This in turn reduces milk yield in cattle and buffalo (Pande et al. 2003a). Additionally, diseased fodder also commands a lower price in the market (Rama Devi et al. 2000). There was, therefore, an urgent need for scientists and researchers to come up with new cultivars complete with sustainable and affordable production technologies such as Integrated Disease Management (IDM) that could resist foliar diseases and assure better pod and haulm yields than TMV 2 for resource-poor farmers of the region.

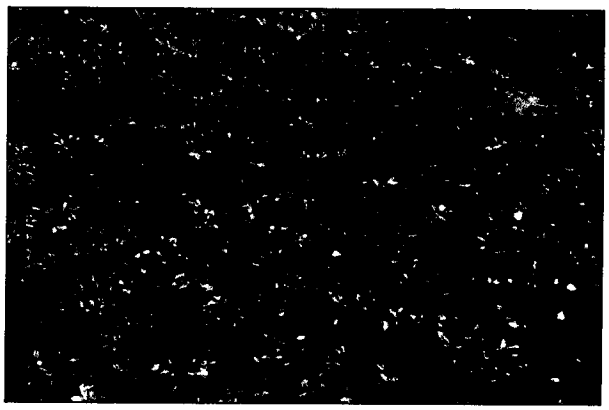


Fig. 5. Severity of late leaf spot and rust under field conditions.

Genesis and identification of IDM-responsive groundnut cultivar ICGV 91114

Keeping in mind various factors, scientists at ICRISAT initiated the development of new cultivars by incorporating farmer-acceptable traits. After extensive research and sustained work and several on-station and on-farm experimentations on integrated disease management, finally they emerged

with ICGV 91114, a dual purpose, early-maturing, IDM-responsive cultivar bred and developed at ICRISAT-Patancheru that had the potential to replace the local cultivar, TMV 2.

ICGV 91114: Characteristics

ICGV 91114 was derived from the bulk pedigree method from ICGV 86055 x ICGV 86533 cross. It is a short duration cultivar and matures in 90-95 days in the rainy season (Fig. 6). It is well suited for rainfed cultivation in the Deccan Plateau. ICGV 91114 is a high yielding, Spanish variety and has erect growth habit with green to light green leaves.

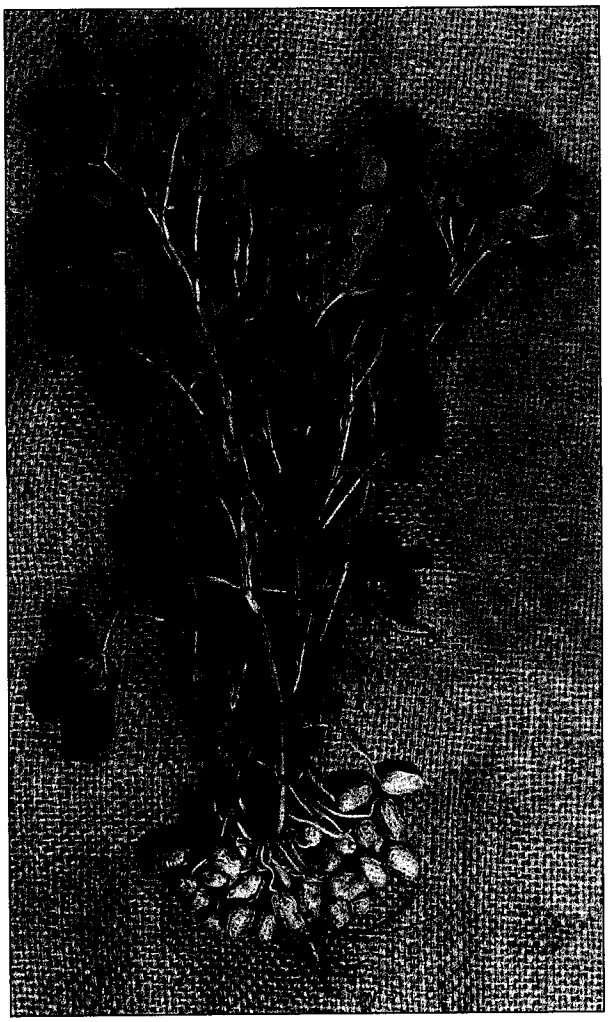


Fig. 6. ICGV 91114 with matured pods.

Phenotypically, it resembles TMV 2. It is tolerant to foliar diseases (LLS and rust) and responsive to their management. It has the potential to withstand mid-season and end-of-season droughts. It produces healthy fodder, which has high nutritional value and better digestibility in cattle and buffaloes. Its pod and haulm yields are significantly higher than TMV 2.

Pods mostly contains two seeds, occasionally three although one seeded pods are not uncommon. Pods contain slight ridges and reticulation with a slight beak and constriction (Fig. 7). It has an average shelling turnover of 75%. Its seeds are tan in color with 100-seed mass of 41 g (Fig. 8). Oil content of the seeds is 48%.

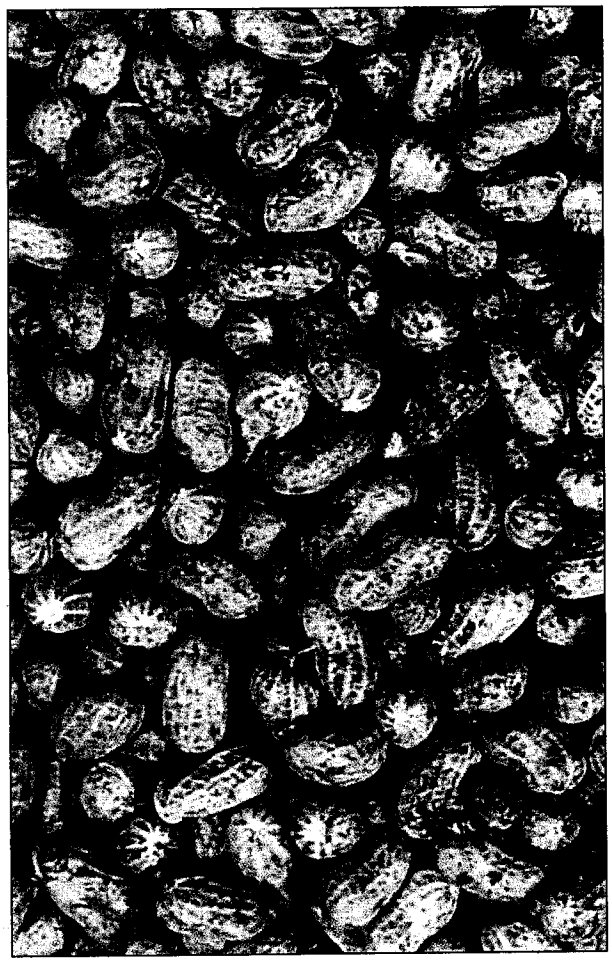


Fig. 7. Pods of ICGV 91114.

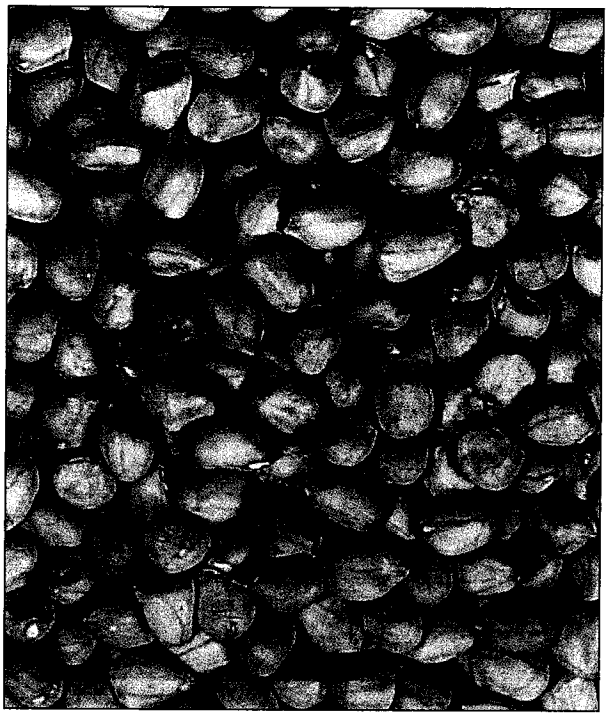


Fig. 8. Kernels of ICGV 91114.

Tests on ICGV 91114 for host plant resistance

ICGV 91114 was rigorously tested and subjected to comparative studies with several other cultivars. On the whole, nine early-maturing cultivars (ICGVs 89104, 91114, 91116, 91123, 92209, 92267, 92269, 94360, 94361) along with a susceptible TMV 2 were evaluated for foliar disease resistance (LLS and rust) during 1994 and 1995 rainy seasons at ICRISAT-Patancheru. The experiments were conducted in a randomized complete block design and replicated thrice (Fig. 9). LLS and rust severities were scored on 1-9 rating scale at 10-day intervals from 45 days after sowing (DAS) till maturity. Pod and haulm yields were recorded after harvesting.

Fig. 9. Identification of host plant resistance under field conditions.

ICGV 91114 easily led the results: severities of LLS and rust were significantly low, and pod and haulm yields were higher than all tested cultivars and TMV 2 (Table 2).

Tests on IDM components

Management of seed and seedling diseases

Various characteristics of ICGV 91114 were examined under IDM practices. As seed treatment, the technology included fungicide application to seed. Since plant density plays an important role in determining yields in groundnut, it is imperative to protect the crop from seed and seedling rots upto 30-35 days after sowing (DAS). Soil-borne pathogens such as *Aspergillus niger*, *Sclerotium rolfsii*, *Rhizoctinia solani* and *Rhizoctinia bataticola* cause seed and seedling rots in early growth stages of the crop. Of the several fungicides and their combinations tested for seed treatment, thiram + carbendazim (1:1) @ 2.5 g/kg seed was found to effectively control these pathogens and was included as an integral part of the IDM package recommended for ICGV 91114 and other cultivars tested alongside.

Management of foliar diseases

Another aspect of the technology was foliar application of fungicide, which helps manage fungal diseases, LLS and rust at later stages of crop growth. An experiment was conducted at ICRISAT-Patancheru to ascertain the most economical combination of fungicide and cultivar for higher pod and haulm yields during 1994 and 1995 rainy seasons. Apart from ICGV 91114, three early-maturing cultivars, ICGVs 89104, 91123 and 94361 and a susceptible TMV 2 were tested. The treatment involved five fungicide spray schedules with chlorothalonil (kavach) @ 2 g/liter water and 500 liters of solution/

Table 2. Performance of ICGV 91114 in comparison with other early-maturing groundnut cultivars with regard to severities of late leaf spot and rust, and pod and haulm yields in the 1994 and 1995 rainy seasons, ICRISAT-Patancheru.

	Disease score on a 1-9 rating scale		Yield t/ha	
Cultivar	LLS	Rust	Pod	Haulm
ICGV 89104	5.7	5.5	1.75	2.18
ICGV 91114	**5.0**	**5.0**	**1.82**	**2.47**
ICGV 91116	8.0	7.3	1.62	2.14
ICGV 91123	6.0	5.7	1.70	1.72
ICGV 92209	7.0	7.3	1.42	2.02
ICGV 92267	6.5	6.0	1.20	2.35
ICGV 92269	7.3	7.3	1.74	2.30
ICGV 94360	7.3	7.3	1.60	2.02
ICGV 94361	5.7	5.5	1.65	2.35
TMV 2	9.0	8.7	1.05	1.57

[1] Mean of three replications and two seasons.

[2] Cultivar susceptible to foliar diseases.

ha. The design of the experiment was split-plot with fungicide spray schedules as main plots and cultivars as sub-plots with three replications. Fungicide sprays were scheduled as follows: (1) one spray at 60 DAS, (2) two sprays at 60 and 75 DAS, (3) three sprays at 60, 75 and 90 DAS, (4) continuous spray from 30 DAS till maturity at 10-day intervals and (5) no fungicide spray (Fig. 10). Severities of LLS and rust were recorded on a 1-9 rating scale at 10-day intervals from 30 DAS till maturity.

LLS and rust severities were low in all early maturing cultivars and once again, ICGV 91114 fared better on all counts. In all spray schedules, the cultivar had lower foliar diseases and higher pod and haulm yields than other early-maturing cultivars and TMV 2.

The IDM package

Based on ICGV 91114's high performance for host plant resistance and following tests for optimal treatments, an IDM package was put together to support the cultivar. The moderately-resistant ICGV 91114 was to be accompanied with:

- Seed treatment with thiram + carbendizim (1:1) @ 2.5 g/kg seed
- Foliar application of fungicide chlorothalonil @ 2 g/liter water and 500 liters of chemical solution/ha at 60 DAS

The IDM technology was tested, and pod and haulm yields were found to be significantly higher in ICGV 91114, followed by ICGV 89104. Haulms too were found to be healthier in these two cultivars. Consistently outstripping the local cultivar TMV 2, these two early-maturing cultivars were shortlisted as candidates for on-farm studies.

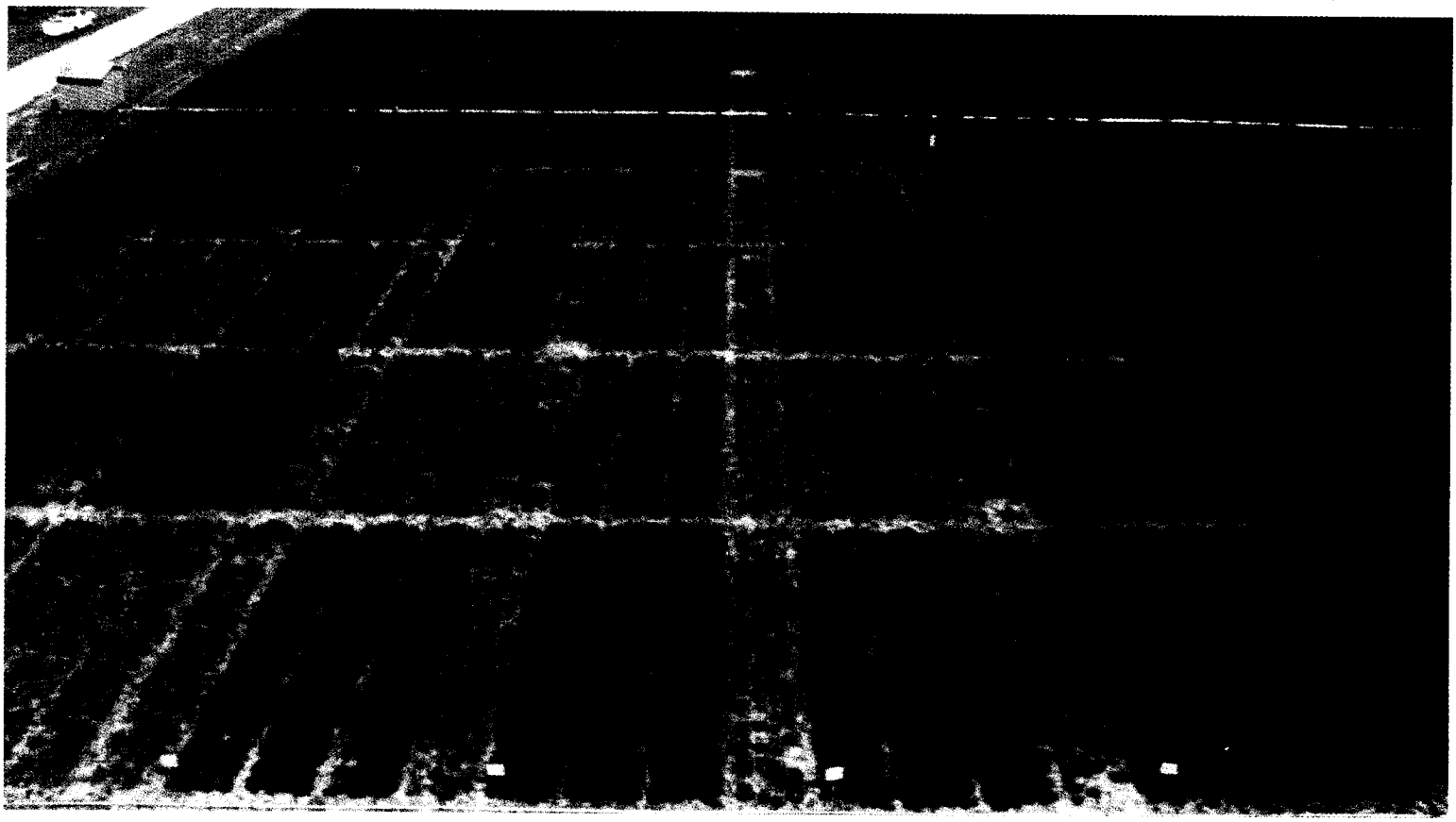


Fig. 10. Testing IDM components on ICGV 91114.

Farmers test IDM and ICGV 91114

Despite best efforts, the distance between the plant pathologist and the farmer remains great. To narrow this distance between technology generation, technology transfer and technology adoption, it is essential that farmers are involved in developing and fine-tuning technology according to their own needs and in their own context. To evaluate the shortlisted cultivars and finally zero in on a variety that could give them maximum returns, farmers' participatory on-farm research was conducted.

The research took place in three phases. In the first phase between 1995 and 1998 (funded by ICRISAT core funding), participatory appraisals were conducted in selected villages, and two early-maturing cultivars, ICGV 91114 and ICGV 89104 were identified as good performers. They were also evaluated with the IDM package. The second phase, 1999-2002, was funded by the United Kingdom's Department for International Development (DFID). After further on-farm evaluations, ICGV 91114 was identified as a dual-purpose cultivar and began to spread beyond farmers involved in the evaluations to several villages in Andhra Pradesh, Karnataka and Tamil Nadu. In the third phase (also funded by DFID), 2003-2004, ICGV 91114 and its associate IDM technology was promoted in a bigger way and involved even larger number of farmers in these three states.

Phase 1 (1995 - 1998)

Participatory rural appraisals. To understand farmer perceptions of the effects of foliar diseases on yield and the nutritive value of groundnut crop residues, participatory rural appraisals (PRAs) were conducted in selected villages (Fig. 11).

Fig. 11. Participatory rural appraisals were carried out in selected villages.

Groundnut crop residues constitute a major source of fodder for ruminants in this region. Results revealed that foliar diseases reduce not just pod and haulm yields but also diminish the quality of crop residues (haulms). This leads to feed refusal and poor health in ruminants (Rama Devi et al. 2000). Farmers also reported over 50% losses in foliage and fodder yield every year due to diseases. With PRAs, it was clear that farmers preferred a cultivar that matured early, had higher potential pod and haulm yields, and displayed greater tolerance to disease and drought than the traditional cultivars, TMV 2 and JL 24.

Participatory varietal selection. On-farm farmers' participatory varietal selection (PVS) trials are another way of bringing down the gap between researchers and end-users. What PVS does is offer farmers several varietal choices to choose from, and enable them to test these cultivars on their own farms, under their own conditions and choose one or two that suit them most.

PVS trials in this phase were conducted in four villages from three districts: two villages from Anantapur, and one each from Kurnool and Nalgonda in Andhra Pradesh. Several organizations collaborated in conducting the trials: Agricultural Research Station (ARS), Acharya NG Ranga Agricultural University (ANGRAU), Anantapur; Rural Development Trust (RDT), Anantapur; Krishi Vignana Kendra (KVK)-Banaganapalle, Kurnool; and KVK-Gaddipalle, Nalgonda. During the 1995 rainy season, eight farmers participated in the evaluation of ICGV 91114, along with eight other early-maturing cultivars that were tested in on-station experiments (ICGVs 89104, 91116, 91123, 92209, 92267, 92269, 94360, 94361) and a local cultivar with IDM technology. Each cultivar in each trial was planted in 500 m^2 in a strip plot design with one replication. Each cultivar-plot was divided into two halves – one half was given IDM and the other was treated to typical farmer practices (non-IDM). LLS and rust severities were scored on a 1-9 rating scale at maturity in all locations. After harvesting, pod and haulm yields were recorded from three pre-demarcated 1 x 1 m plots in each treatment.

Results revealed significantly lower severities of foliar diseases (LLS and rust), and higher pod and haulm yields in all improved early-maturing cultivars compared to the local cultivar. As with the on-station trial, ICGV 91114 led the field, followed by ICGVs 89104, 91123 and 94361 (Table 3).

Based on farmer perceptions of desirable traits, four cultivars – ICGVs 91114, 89104, 91123 and 94361 – were selected for further on-farm evaluation the following year, the 1996 rainy season. Twenty four farmers from 10 villages from the three districts participated in the trials and the methodology was exactly same as the previous year (Fig 12).

Of the four cultivars evaluated, ICGV 91114 and ICGV 89104 were marked out for further evaluation as they were once again found superior with low diseases and higher yields (Table 4).

In 1997, on-farm research at ICRISAT was devolved; ARS-Anantapur and RDT, Anantapur, took up farmers' participatory on-farm research. The two early-maturing cultivars, ICGVs 91114 and 89104, were evaluated with IDM technology; sixty farmers from two villages in Anantapur districts participated. In 1997 and 1998, severities of foliar diseases were significantly low and pod and haulm yields were high in both new cultivars in IDM plots compared to the local cultivar in non-IDM plots.

Table 3. Performance of ICGV 91114 in comparison with other groundnut cultivars with regard to severities of late leaf spot and rust, and pod and haulm yields in on-farm IDM trials in Anantapur, Kurnool and Nalgonda districts, 1995 rainy season.

Cultivar	Disease score on a 1-9 rating scale		Yield t/ha*	
	LLS	Rust	Pod	Haulm
ICGV 89104	5.3	5.7	1.26	2.35
ICGV 91114	**5.0**	**4.7**	**1.49**	**2.28**
ICGV 91116	7.0	6.0	1.21	2.13
ICGV 91123	5.7	5.0	1.23	1.30
ICGV 92209	7.3	6.3	1.19	1.93
ICGV 92267	6.0	5.0	1.13	1.73
ICGV 92269	6.5	5.5	1.28	2.20
ICGV 94360	5.5	5.3	1.20	2.15
ICGV 94361	5.5	5.3	1.35	2.20
Local	8.7	7.5	1.09	1.90

* Mean of eight farmers.

Fig. 12. On-farm evaluation of groundnut cultivars.

Table 4. Performance of ICGV 91114 in comparison with other groundnut cultivars with regard to severities of late leaf spot and rust, and pod and haulm yields in on-farm IDM trials in Anantapur, Kurnool and Nalgonda districts, 1996 rainy season.

Cultivar	Disease score on a 1-9 rating scale		Yield t/ha*	
	LLS	Rust	Pod	Haulm
ICGV 89104	5.7	3.9	1.55	2.59
ICGV 91114	**5.0**	**3.4**	**1.75**	**2.69**
ICGV 91123	6.3	4.5	1.35	2.10
ICGV 94361	5.0	4.0	1.50	2.43
Local	8.7	7.5	1.03	1.59

* Mean of 24 farmers from three districts.

During this period, the two cultivars spread to several farmers within the selected villages (Pande et al. 2001).

Phase 2 (1999 - 2002)

During the second phase, ICRISAT (Project ZA No. 0286 funded by DFID) restored its on-farm research for further evaluation of the two cultivars, ICGVs 91114 and 89104, in Andhra Pradesh, Karnataka and Tamil Nadu.

The number of participating farmers for each year were:	
1999	42 farmers from 25 villages from the three states
2000	47 farmers from 20 villages from the three states
2001	21 farmers from one village in Andhra Pradesh

In addition, several farmers not directly involved with the program also adopted the cultivar ICGV 91114 and its IDM package in all three states.

Collaborating institutions during this phase were:

- ARS, Anantapur;
- District Agricultural Advisory and Transfer of Technology Center (DAATT Center), Anantapur, (ANGRAU); and
- Agricultural Man Ecology (AME) with its network of NGOs:
  - Mysore Resettlement and Development Agency (MYRADA), Andhra Pradesh and Karnataka
  - Rural Reconstruction Society, Andhra Pradesh
  - Andhra Pradesh Rural Reconstruction Mission, Andhra Pradesh
  - Reorganisation of Rural Economy and Society, Karnataka
  - Pakruti, Karnataka
  - Gram Vikas, Karnataka
  - Prayog, Karnataka
  - AME-Raichur, Karnataka
  - MYRADA-Shoolagiri, Tamil Nadu

Although severities of foliar diseases were low in both cultivars in 1999 and 2000 rainy seasons, farmers preferred ICGV 91114 to ICGV 89104 because of its overall superiority (Table 5). Finally, the dual-purpose ICGV

Table 5. Performance of ICGV 91114 in comparison with other groundnut cultivars with regard to severities of late leaf spot and rust, and pod and haulm yields in on-farm IDM trials in Andhra Pradesh, Karnataka and Tamil Nadu, 1999 and 2000 rainy seasons.

	Disease score on a 1-9 rating scale						Yield t/ha*					
	LLS			Rust			Pod			Haulm		
State (no. of trials)	ICGV 89104	ICVG 91114	Local CV	ICGV 89104	ICVG 91114	Local CV	ICGV 89104	ICVG 91114	Local CV	ICGV 89104	ICVG 91114	Local CV
Andhra Pradesh	5.5	5.0	7.0	5.0	4.5	6.5	1.85	1.95	1.25	2.25	2.30	2.10
Karnataka	5.0	4.5	7.5	4.5	4.0	7.5	1.70	1.85	1.15	2.35	2.50	2.05
Tamil Nadu	5.3	5.0	7.5	5.0	5.5	7.5	1.60	1.75	1.10	2.05	2.05	2.00

* Mean of 89 farmers, 1999-2000.
CV=Cultivar

91114 emerged as a probable alternative to the reigning cultivar TMV 2 for cultivation in the drylands of the region. Since 2000, ICGV 91114 has been vigorously promoted by ICRISAT and its collaborators. The cultivar and its IDM technology has been increasingly adopted and has spread from farmer to farmer, from village to village.

Tests on fodder quality

Groundnut residue is a major source of fodder for cattle and provides 'feed security' for ruminants in this region (Fig. 13). Comparative *in vitro* analysis of haulms of ICGV 91114 (IDM-treated) and TMV 2 (unprotected) was conducted at ICRISAT-Patancheru by animal nutritionists from the International Livestock Research Institute (ILRI).

Results revealed that percent fermentation gas, nitrogen, crude protein and digestibility were higher in the haulms of ICGV 91114 than with TMV 2 (Table 6). In effect, ICGV 91114 with its IDM technology ie, with minimum protection of one fungicide application at 60-65 DAS, produced higher quality fodder for ruminants (Pande et al. 2003). Later, animal feeding trials were also conducted with participating farmers in two villages in Anantapur district. These tests confirmed that ICGV 91114 produces healthy fodder, which has high nutritional value and better digestibility in cattle and buffaloes.

Phase 3 (2003 - 2004)

In this phase, 258 farmers from eight villages in Anantapur district further evaluated and participated in promoting and upscaling ICGV 91114 and its IDM technology. Collaborating organizations in this phase were DAATT Center, Anantapur; ARS-Anantapur (ANGRAU) and RDT-Anantapur.

Table 6. Percent *in vitro* fermentation gas, nitrogen, crude protein and digestibility of ICGV 91114 and TMV 2, ICRISAT-Patancheru.

Parameter	ICGV 91114*	TMV 2**
Fermentation gas	48.2	30.3
Nitrogen	2.2	1.8
Crude protein	14.1	11.3
Digestibility	66.2	51.4

* Economical management of foliar diseases by one fungicide spray at 60 DAS (IDM technology).
**No management of foliar diseases and no fungicide application (farmers'practice, ie, non-IDM technology).

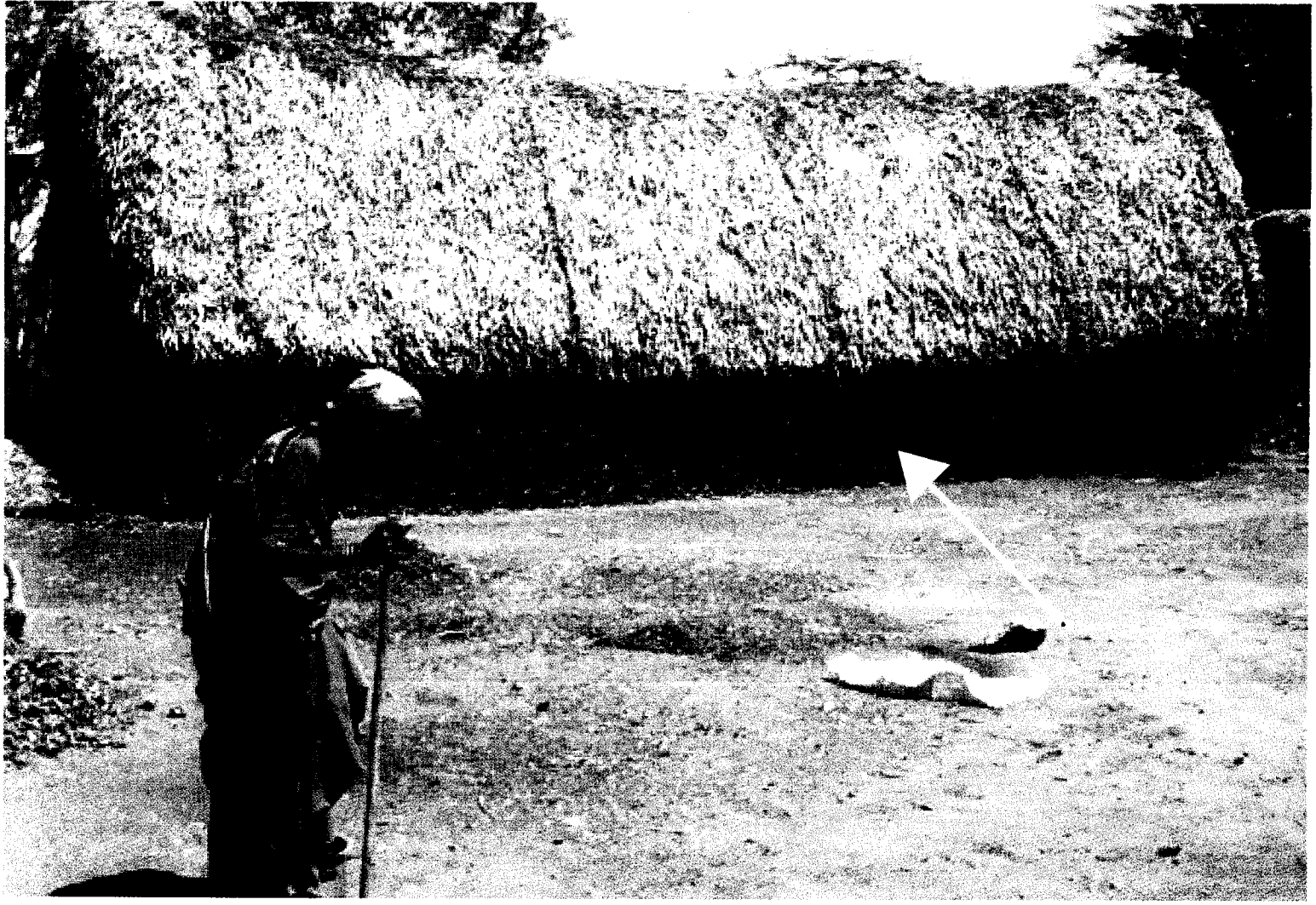


Fig. 13. Stacks of groundnut fodder provide feed security for ruminants.

The trials proved that the dual-purpose cultivar was consistently and substantially superior in terms of low foliar disease and high pod and fodder yields (Table 7). As with previous years, haulm quality was exceptionally good/healthy compared to the local cultivar. Farmers also noted increases in milk yield when haulms of this cultivar were fed to milch animals. As a result, ICGV 91114 became very popular with farmers and was rapidly disseminated to neighboring districts in Andhra Pradesh, Karnataka and Tamil Nadu.

Economics

There are considerable economic advantages to growing ICGV 91114 because farmers benefit from increased crop and haulm yields as well as milk production. Gross and net returns on farm are higher, and per unit costs of production are lower for the cultivar under both irrigated and rainfed conditions. Results from a study in 2004-05 are presented in Table 8, showing costs and returns from growing the improved cultivar versus local varieties TMV 2 and JL 24 in three villages under rainfed and irrigated conditions. Pod and haulm yields were highest for ICGV 91114 over the local cultivars. Gross returns too were higher. Although the costs of cultivation of ICGV 91114 are higher, overall cost of production were 9% lower for the new cultivar under irrigation and 8% lower under rainfed conditions. Net returns from ICGV 91114 were about 29% higher under

Table 7. Performance of ICGV 91114 in comparison with local groundnut cultivars with regard to severities of late leaf spot and rust, and pod and haulm yields in on-farm IDM trials in Andhra Pradesh, 2002-2004 rainy seasons.

	Disease score on a 1-9 scale				Yield t/ha*			
	LLS		Rust		Pods		Haulms	
Year	ICGV 91114	Local CV	ICGV 91114	Local CV	ICGV 91114	Local CV	ICGV 91114	Local CV
2002	3.0	4.5	3.5	4.5	1.55	0.90	1.70	1.45
2003	4.5	6.7	3.5	6.0	1.60	1.00	2.10	1.75
2004	5.0	7.5	5.0	7.5	2.15	1.75	2.80	2.25

* Mean of 310 farmers from 2002 to 2004.

Table 8. Cost inputs and returns from local cultivars vis-à-vis ICGV 91114, Anantapur*, 2004-2005.

	Irrigated			Rainfed	
Parameters	TMV2	JL 24	91114	TMV2	91114
Cost of cultivation (Rs/ha)	9558	10008	10472	8814	9561
Cost of production (Rs/kg)	7.2	8.2	6.7	8.5	7.8
Pod yield (kg/ha)	1322	1216	1567	1040	1231
Haulm yield (kg/ha)	1730	1730	2224	1483	1730
Gross returns (Rs/ha)	24291	24637	29450	19215	22541
Net returns (Rs/ha)	14733	14629	18978	10403	12981

* Mean of sample farmers from three project villages.

irrigation and 25% higher under rainfed conditions.

There are various factors that influence the economics of groundnut production. Seed is the most expensive input accounting for 36-42% of total costs. Prices vary between cultivars, but differences are relatively small. Labor is the next most expensive input accounting for 24-29% of total costs, followed by fertilizers (10-11%). Currently, farmers receive higher prices for selling seed of improved cultivars than for traditional varieties. Milk yields from improved cultivars are higher than those from local varieties. About 70-80% of the milk obtained is sold, and income from this ranges between 15-25% at the household level. The advantages of growing improved cultivars therefore is threefold:

1) Higher pod yields,
2) Higher haulm yields, and
3) Higher milk yields from dairy animals fed with these haulms.

On the basis of yield and economic parameters estimated from the field, and assumptions with regard to adoption, experts have assessed the economic implications of the new cultivar. Accordingly, the incremental benefit in 2005 would be around Rs 60.6 million ($1.37 million), which breaks up into Rs 51.4 million ($1.16 million) due to groundnut crop and 9.2 million ($0.20 million) due to dairy. These incremental benefits progressively increase to Rs 121.3

million ($2.75 million) in 2007 and Rs 242.5 million ($5.51 million) in 2009. The cumulative benefit for the next five years has been estimated at around Rs 848.7 million ($19.28 million).

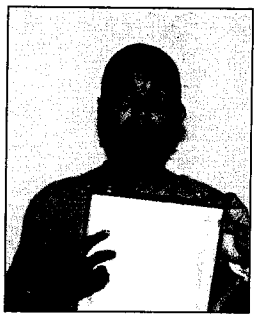
Farmers' perceptions of ICGV 91114

Farmers loved ICGV 91114 for several reasons. Table 9 presents a summary of their perceptions.

Both participating and non-participating farmers observed the performance of the crop from seedling emergence to maturity and were convinced of the cultivar and its IDM technology. Drought is a common phenomenon in the Deccan Plateau. This cultivar escapes mid-season and end-of-season drought, which is another reason why farmers approve of this cultivar.

P Indiramma, Jalalapuram

I followed the IDM technology suggested by ICRISAT scientists and found fodder from ICGV 91114 to be very good for milch animals. The haulms were less diseased and retained more leaves. My buffaloes started to give one extra liter of milk after being fed haulms from this variety. The variety also yielded 1½ times more pods than the local variety. I observed the crop both in kharif and rabi and it was excellent in both seasons. The crop matures 15 days earlier than our local variety. I sowed 45 kg seed and obtained 35 bags of pods (40 kg/bag).



S Linga Reddy, Jalalapuram

I have a lot of experience growing TMV 2 and JL 24. In the last two years, I have been growing ICGV 91114 from ICRISAT, and also following the IDM technology recommended by the scientists. In my observation, the dual-purpose ICGV 91114 gave higher pod and fodder yields compared to JL 24. I gave some seed to other farmers and sold the rest in the market at a premium price. All farmers in my village are very happy with ICGV 91114 because it gave higher yields even under

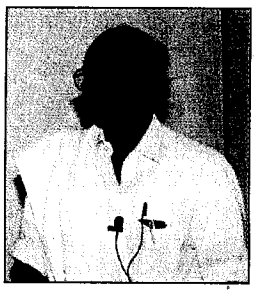


Table 9. Farmer perceptions of desirable characteristics of ICGV 91114.

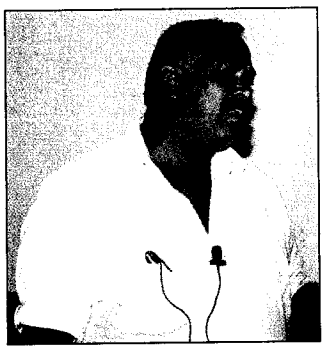
Character	Perception
Plant stand	Optimum with high seedling vigor
Flowering	Flowers are more numerous and synchronous
Duration	Matures earlier than local cultivar
Foliar diseases	Foliar diseases are lower than with local cultivar
Drought	Withstands drought well
Yield	Pod and fodder yields higher than local cultivar
Fodder quality	Healthy fodder with green leaves; relished by cattle
Milk yield	Increased

Local cultivar=TMV 2, JL 24, Vemana.

drought conditions. The fodder is also very healthy and milk yield has increased after it was fed to milch animals.

G Pulla Reddy, Talupuru

I have planted two varieties of groundnut, ICGV 91114 and ICGV 92093 along with my own variety JL 24. I received these new varieties from ICRISAT and implemented the IDM technology suggested by ICRISAT scientists. Surprisingly, foliar diseases – which are major yield and quality reducers – were low in both the new cultivars compared to our local cultivar JL 24. The quality of fodder was very high, ie, there was low foliar disease. The animals relished the haulms and gave more milk than they used to.



Many farmers in my village have made similar observations.The cultivar is so good, I had 20 acres under ICGV 91114 in 2005.

T Surya Chandra Reddy, Talupuru

ICRISAT scientists (Suresh Pande and his group) gave me groundnut seed of two varieties: ICGVs 91114 and 89104 to try out. Both these cultivars are high yielding and gave 50-60 bags (40 kg/bag) of pod and very high yield of haulm under IDM. These cultivars were also more resistant to diseases compared to the local cultivar. The fodder from these varieties was kept and fed to milch animals; there was a definite increase in milk yield as a result. I observed that the health of the buffaloes also improved. ICGV 91114 in particular withstands drought better than the local variety. It can be grown under rainfed conditions as well as under irrigated conditions.

Impact

ICGV 91114 and IDM technology has gradually spread from participatory trials in a few villages to several villages in Andhra Pradesh, Karnataka and Tamil Nadu.

- In 1995, ICGV 91114 and its IDM technology was evaluated by eight farmers in four villages in three districts in Andhra Pradesh.
- In 1996, 24 farmers were involved in evaluating this cultivar in the same districts.
- During 1997 and 1998, 60 and 260 farmers respectively sowed ICGV 91114 in four villages in Anantapur.
- In 1999, the cultivar was sown in 780 farmers' fields in Andhra Pradesh (Anantapur, Chittoor, Kurnool and Nalgonda districts), Karnataka (Kolar and Raichur districts) and Tamil Nadu (Dharmapuri district).
- In 2000, 1240 participating and non-participating farmers were involved in evaluating this cultivar in the same locations as 1999.
- ICGV 91114 spread rapidly across villages and districts. It was taken up by 2180 farmers in 2001, 3230 farmers in 2002, 5650 farmers in 2003 and 8940 farmers in 2004 (Fig. 14).
- More than 10,000 farmers have been estimated to cultivate ICGV 91114 during the 2005 rainy season.

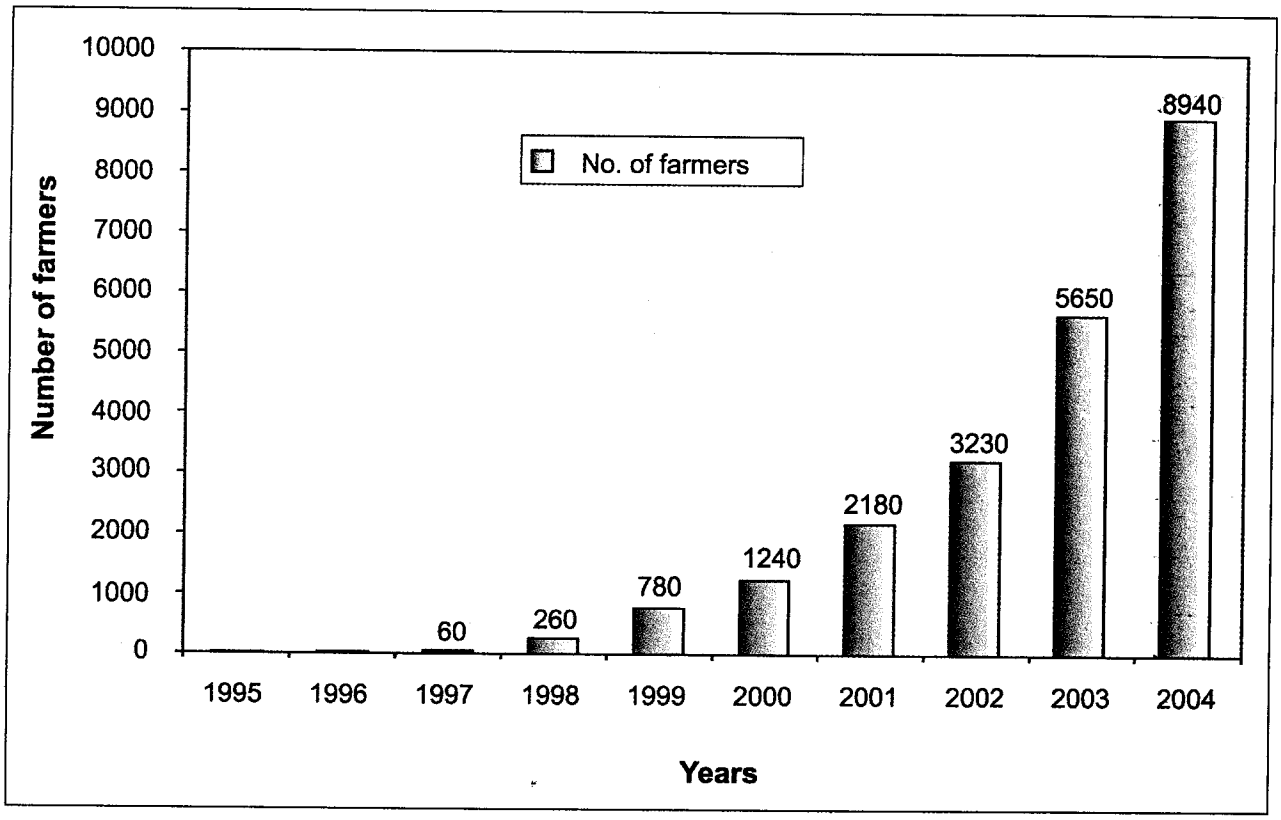


Fig. 14. Number of farmers that adopted ICGV 91114 and IDM technology over the years.

At the current rate of expansion, it is anticipated that some 80,000 hectares (10% of the total crop area) in Anantapur will be under ICGV 91114 by 2010 and that seed will be disseminated into adjoining states Karnataka and Tamil Nadu.

Looking ahead: The seed village

Seed is a very important and rather expensive component in groundnut cultivation. The crop also suffers due to the lack of an organized seed system in the Deccan Plateau. Most farmers store their kharif produce as seed for the following season, a practice that has been threatened in recent years due to the storage pest 'bruchid' that has become a major menace to small farmers. Since the seed-to-grain multiplication ratio is very low in groundnut, it is not possible for a single agency to supply seed to all groundnut-growing farmers in the Plateau. To ensure the availability of groundnut seed to every farmer, what is needed is a 'seed village' – a concept that was encouraged and implemented by us in selected villages, either through NGOs or through self help groups, under the DFID project. For instance, 9 farmers in village Jalalapuram, 13 in Lingareddypally, 4 in Talupuru and 3 in Vasanthapuram in Anantapur involved themselves in seed production of the cultivar ICGV 91114 during the 2004 postrainy season. The seed was then sold to other farmers in and around the area for planting in the 2005 rainy season (Fig. 15).

For ICGV 91114 to successfully replace TMV 2, it is important for villages to produce seed and spread the variety to other villages through self help groups and NGOs. Only then can farmers be assured of a sustainable supply of seed.

Fig. 15. Preparing the seed of ICGV 91114 for planting.

Fig. 16. Cleaned and ready to be sown: A happy farmer looks at his next potential crop.

Fig. 17. ICGV 91114 and IDM result in a healthy crop.

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