Participatory research using on-farm monitoring and simulation: spring-sown mungbeans

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Abstract

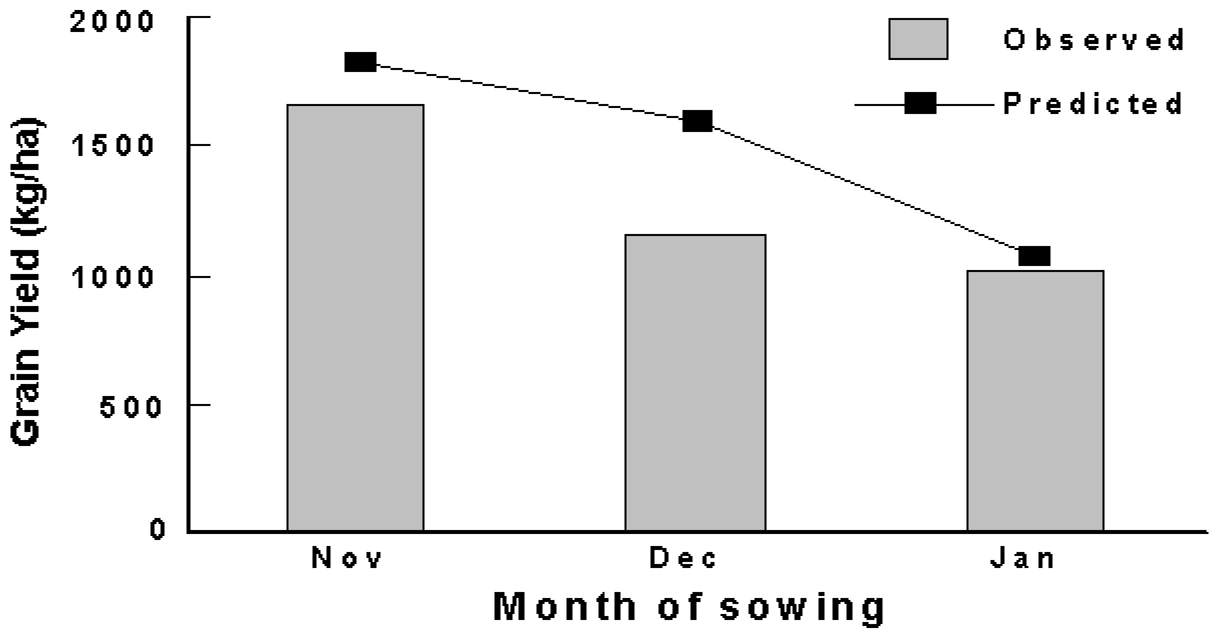
Mungbean it is commonly sown as an opportunity crop on low soil water and has a reputation for being a low yielding, high risk crop. Yield prospects could be improved and risks reduced if it was sown in spring after a winter fallow. However, there is a lack of experience and confidence in alternative roles for mungbean in the farming system. This paper describes a research approach involving researchers, farmers, advisers and traders in which on-farm monitoring of spring-sown commercial crops and cropping systems simulation was used with APSIM, to explore yield prospects for a spring-sown crop after a winter fallow. The key elements of the approach are (i) identification of possible options through simulation of scenarios, (ii) testing the new practice with innovative farmers, and (iii) monitoring of the management and performance of commercial crops and comparing yields with benchmarks estimated with a model. We propose that this approach could be applied to other farming systems.

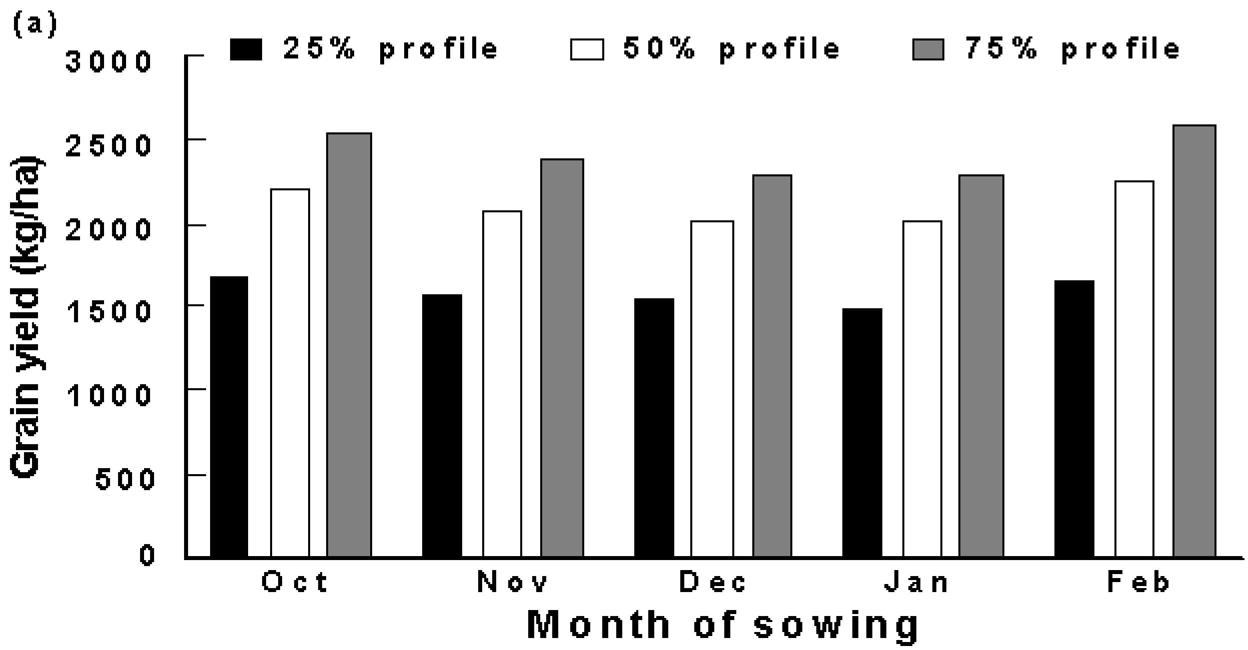
Key words: Mungbean, modelling, participatory research.

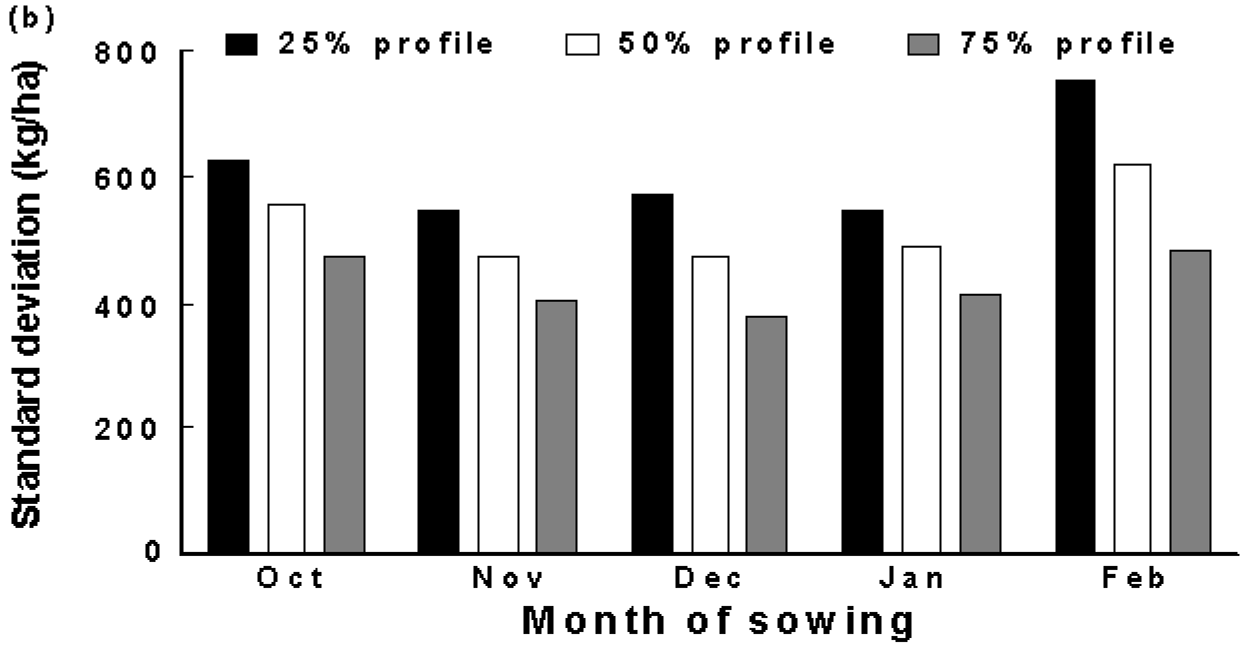
IMungbean as a dryland cropping option in the sub-tropics suffers from poor farmer perception as a low yielding, high risk crop, due to the fact that it is commonly sown as an opportunity crop on low soil water, often doubled-cropped after winter cereals. We suggest that an alternative perception for the crop could be promoted by considering mungbeans as an option for sowing after fallow in spring. This would improve the yield prospects and decrease the riskiness of returns from the crop, and allow the possibility of double-cropping into wheat through the extra soil water accumulated after the early mungbean harvest. However, there is a lack of experience and confidence in alternative roles for mungbeans in the farming system.

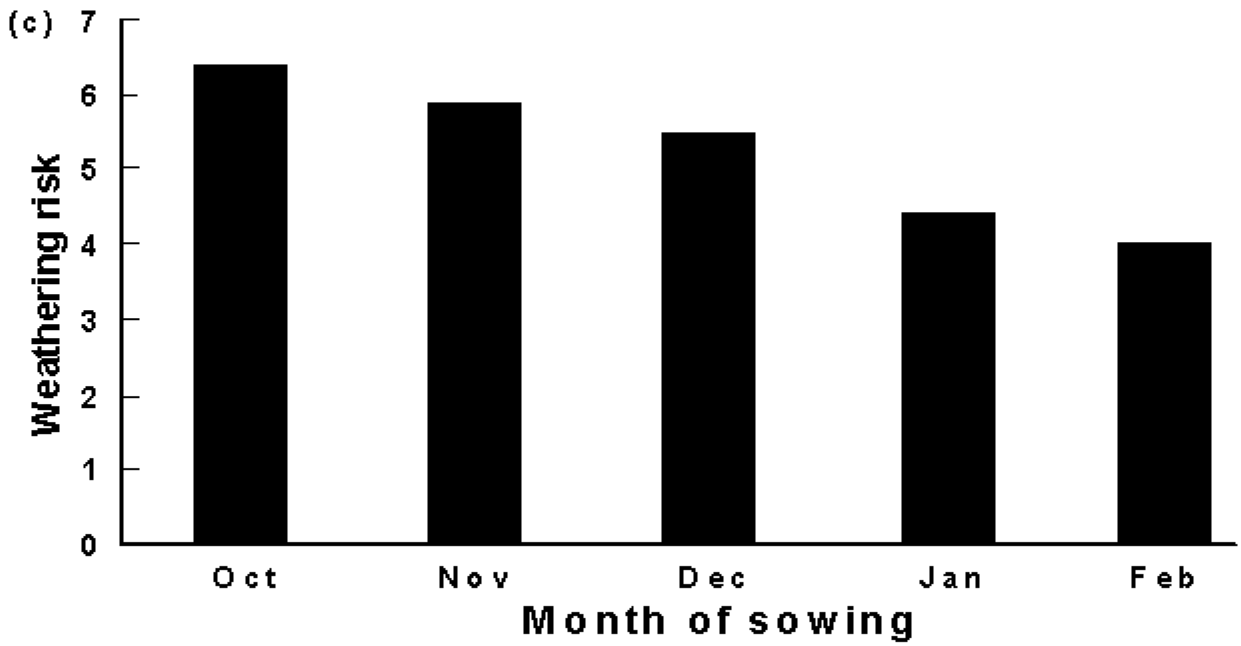
In a traditional mode of research and development, this type of problem would be tackled by conducting a program of experiments on research stations, manipulating the main agronomic variables of interest (eg. sowing date, variety), and then extending the results to farmers as recommendations. This paper describes an alternative process where a participative approach, involving researchers, farmers, traders and advisors explored prospects for spring-sown mungbean after a winter fallow.

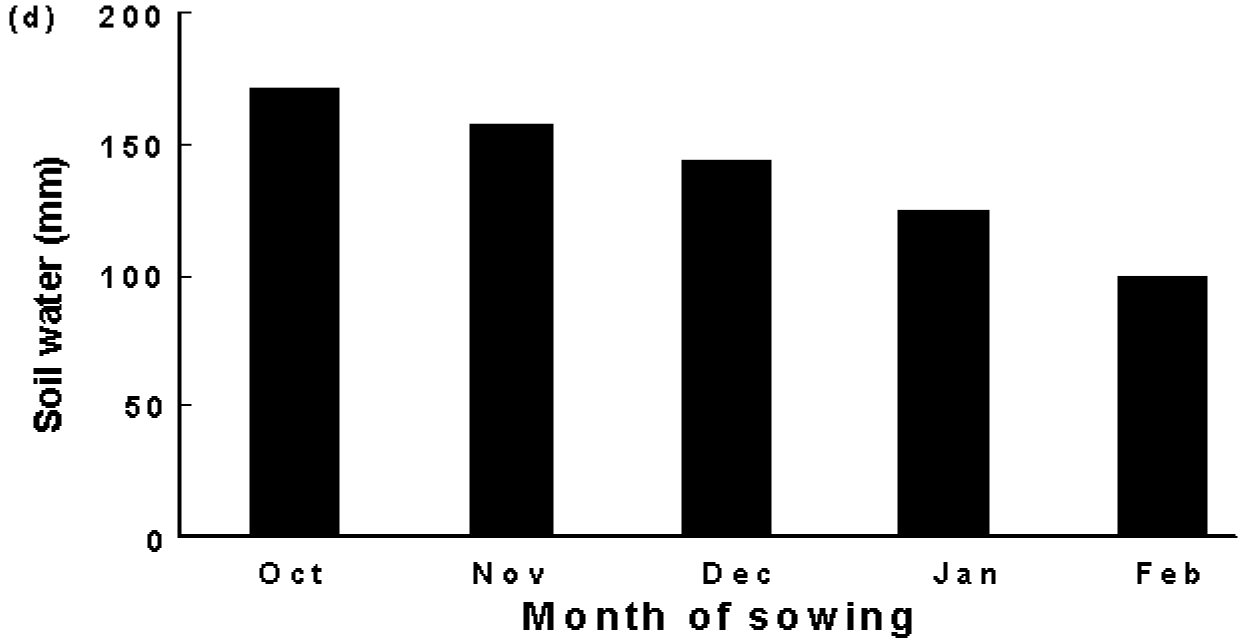
Identifying the opportunity through scenario analysis


2000
1500
1000
500
0
Grain Yield (kg/ha)
Observed
Predicted
Nov
Dec
Jan
Month of sowing


(a)
25% profile
50% profile
75% profile
3000
2500
2000
1500
1000
500
0
Grain yield (kg/ha)
Oct
Nov
Dec
Jan
Feb
Month of sowing


(b)
25% profile
50% profile
75% profile
Standard deviation (kg/ha)
800
600
400
200
0
Oct
Nov
Dec
Jan
Feb
Month of sowing


(c)
Weathering risk
7
6
5
4
3
2
1
0
Oct
Nov
Dec
Jan
Feb
Month of sowing



The prospects and opportunities for spring-sown mungbeans in the dryland sub-tropics was analysed through simulation with the mungbean module of the Agricultural Production Systems Simulator (APSIM) (3). The mungbean module was developed within the APSIM crop template (1). The module gave reasonable predictive ability when tested against 63 commercial and research station crops from the Darling Downs, Northern Territory, and Ord River spanning grain yields (o.d.) of 334 to 2560 kg/ha, with 75% of variation explained. The module predicted the declining trend of grain yield with delayed sowing date (Fig. 1). However, none of the datasets used in the testing were from sowings earlier than mid-November.

To explore the impact of sowing date and starting soil water on yield prospects, simulation was conducted with the mungbean module using climate data for the years 1955 to 1995 at Dalby, Queensland (latitude 27.09 ^{o}S). Dryland crops of cv. Emerald were planted on the 15 October, November, December, January and February, using a plant population density of 20 plants/m^{2} and a row spacing of 50 cm. The soil water at sowing was initialised at 54, 103 or 143 mm of plant available water, representing 25, 50 or 75% full profile for a brigalow soil type.

The simulations showed average grain yield declined with sowing date (Fig. 2a). Although the February sowing yielded highest, the modelled yields probably do not reflect reality, as it is unclear to what degree the declining temperature and radiation environment of the autumn limits growth. The October sowing date had higher yield potential than later sowings due to a longer crop duration associated with cooler, early-season temperatures slowing development, rather than a larger amount of in-crop rainfall (data not shown). Higher amounts of plant available water at sowing increased yield (Fig. 2a) and lowered risk (Fig. 2b) at all sowing dates. Associated with earlier sowing was an increased risk of weathering damage (Fig. 2c), measured by the number of rainfall events during the pod-filling phase. The average plant available water present at the first planting opportunity for wheat (25 mm of rain over 5 days between 1 May and 29 July) was simulated to be higher for the early sowings (Fig. 2d), suggesting an improved opportunity for double-cropping into a winter cereal.

Monitoring the experience on-farm

The results of the scenario analysis stimulated the interest of commercial seed traders, as it offered the opportunity to expand the role for the crop in the farming system, improve yield prospects, and spread grain receipts more evenly through the harvesting season. Given the lack of experience and confidence in alternative roles for mungbeans in the farming system, and absence of model validation for spring sowings, the traders encouraged a number of growers to trial a small area of spring-sown mungbean. It was decided to monitor 14 of these paddocks to firstly, benchmark commercial crops to ascertain if they were attaining the climatically-determined yield, and in the process gain confidence in the results of the scenario analysis, and secondly, to gather information on agronomic constraints encountered by growers of spring-sown crops in a commercial context. ?Management was documented using the TOPCROP check cards. All crops were sown after a winter fallow, with commercial yields ranging from 380 to 1530 kg/ha. ?A subsample of 6 paddocks were monitored more intensively with measurements of: pre-sowing and post-harvest plant available soil water using soil cores to the depth of the root zone, daily rainfall, plant population density, and quadrat yields and biomass through the season. these data were used to run, and then check, the simulations of climatically-determined yields.

The 6 intensively-monitored crops varied widely in yield as a consequence of variation in both pre-sowing soil water and in-crop rainfall (Table 1). The lowest yielding crop of 230 kg/ha (oven-dry basis) was sown on a profile containing only 32 mm of plant available water and received 50 mm rainfall during the season. In contrast, the highest yielding crop at 1390 kg/ha was sown on 84 mm and had 175 mm rainfall. This reinforced the results of the scenario analysis, which showed the over-riding importance of pre-sowing soil water on yield. There was good agreement between the quadrat yields and simulated yields indicating the validity of the model in simulating spring sown crops, and that crops were achieving their climatic potential. However, there were a number of cases where commercial yield were substantially less than the benchmark. In two instances, (paddocks 2 and 4) this was traced to high harvester losses. Nearly all growers that were surveyed stressed the importance of timely insect pest management to the attainment of maximum yields. On-farm price varied widely with grain quality. The gross margins calculated for the 6 crops showed that returns comparable to those for sorghum or dryland cotton were attainable, and that spring-sown mungbeans could be considered as a serious option after a winter fallow.

Acknowledgements

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