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Yield Gap Analysis in Major Field Crops of Tamil Nadu

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Authors' contributions

This work was carried out in collaboration among all authors. Author AD designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors VK and MU managed the analyses of the study. Author MU managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Agriculture plays a vital role in Indian economy, contributes 13% of gross domestic product and provides employment opportunities to more than 50% of work force. In India 60% of land area are arable leads to second largest country in terms of total arable land area. The technology development rate is 2 percent and farm productivity rate only increase by 0.3 percent in major crops. It implied that outreach of technology from lab to land have several constraints. In this study, yields gaps of major field crops are calculated with the data provided by the joint directorate of Tamil Nadu, to find, to which extent the advancement in agriculture is helpful and it is found out that the yield gap II of selected varieties of major crops are high. It shows the deviation from the potential yield of the variety with the actual yield obtained by the farmer.

Keywords: Yield gap I; yield gap ii; actual yield and potential yield.

1. INTRODUCTION

Agriculture has been a significant sector in many developing countries across the world for its anticipated capacity to make a significant contribution to achieve developmental objectives such as economic growth, employment generation, food security, poverty reduction and environmental sustainability [1,2]. Agriculture is important to the people of Tamil Nadu as it creates livelihood to about 40 per cent of the population. Government of Tamil Nadu is conferring highest priority to Agriculture sector and the department is taking all efforts to develop the Second Green Revolution to increase the farm productivity and substantially strengthen the income of the farmers. With almost little scope for further expansion in arable lands, there is a need to increase yields to technically maximum possible levels through appropriate investment in basic infrastructure, human development, research and extension services.

1.1 Tamil Nadu Agriculture - Vision 2023

In order to achieve a growth rate of 21 per cent in Agriculture, the productivity in the sector has to increase as there is not much scope for increasing the arable land in the state and this requires immense amount of innovation in agricultural practices, adopting advanced cropping practices to

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suit the local requirements. Infrastructure developments in agriculture are focused at the three initiatives to improve agricultural productivity, assurance of year round irrigation and marketing extension.

The key projects are:

a. Irrigation projects associates connectivity of farms with canals and dams, and cleaning of water resources such as tanks, wells and dams.
b. Micro irrigation under horticulture, vegetables, fruits and spices for 100 per cent of crops.
c. Horticultural parks for fruits, vegetables and spices would be developed all over the state.
d. Storage facilities including cold storage and related logistics facilities.
e. Packing houses and gamma irradiation facilities are to be developed in each district.
f. Grain storage equipment facilities.
g. Three terminal market complexes to serve the export and local market.
h. Strengthen agricultural research and development capabilities.

1.2 Objective

The objective of the study is

1. To analyze the difference between the Potential Yield (in kg/ha) and the Adaptive Research Trail Yield (in kg/ha) i.e., Yield gap I (in kg/ha).
2. To analyze the difference between the Adaptive Research Trail Yield (in kg/ha) and the farmers average trail yield i.e., Yield gap II (in kg/ha).

2. METHODOLOGY

To study the yield gap of major state Potential Yield (in kg), progressive farm yield and actual yield data for individual varieties of major were collected from the Joint Director of Agriculture, Tamil Nadu.

2.1 Yield Gap Analysis

The existing productivity gap is conceptualized as the difference between yield obtained in the research stations and the actual farm yield realized [3]. The yield gap might be due to lag in transfer of technology from research station to farmers and deficiencies in adoption of various technologies by the farmers i.e. inter farm difference in application of technologies [4]. The yield gap exists mainly due to biological and socio economic constraints. Yield gap has three components.

Yield Gap I = Potential Yield – Adaptive Research Trail Yield
Yield Gap II = Adaptive Research Trail Yield – Actual yield

But in our study progressive farmer yield of the state had used proximity to Adaptive Research Trail Yield (in kg/ha). Yield gap I (in kg/ha) caused by environmental difference between experiment stations and Yield gap II (in kg/ha) caused by biological, social, economic and technological constraints. Such as,

- Biological Constraints – Weeds, Pest and disease, Soil fertility, quality of irrigation, problem soil and rainfall
- Economic Constraints – Lack of capital high cost of inputs, low price of produce
- Social Constraints – Traditional beliefs, attitudes of peasant
- Technological Constraints – Lack of awareness about technology, inadequacy of extension techniques

In this study variety wise yield data collected for paddy in Cereals, Ragi in Millets, Red Gram in Pulses, Groundnut in Oil seeds and Sugarcane in Cash crops was worked out to find the gap between potential and actual yield.

3. RESULTS AND DISCUSSION

Yield gap analysis of Paddy, Ragi, Red gram, Groundnut and Sugarcane has analyzed and presented below.

The yield gap between the varieties of rice could be observed from the Table 1. Yield gap I and II using potential, progressive yield of the farmer in the district proxy for adaptive research trail yield and average yield. In these CO 4 shows more Yield gap I than other varieties. CO 51 and ADT 50 shows more gap between Adaptive Research Trail Yield that is Yield gap II. The Figs. 1-4 representing the Yield Gap I and II of Paddy were given in Annexure.

From Table 2, the Yield gap I obtained from this crop CO 15 is less when compared with the other varieties of Ragi, others have more gap between Yield gap I and II. But this variety (CO 15) shows greater gap from adaptive research trail yield to farmer's average yield. The Figs. 5, 6 and 7 representing the Yield Gap I and II of Ragi were given in Annexure.

In this analysis of yield gap between the Red gram varieties the variety APK 1 shows very less difference between them, it gives yield gap I as 672 kg, followed by the variety VBN 1 yield gap I as 872 kg and the variety CO (Rg) 7 shows yield gap II as 387 kg followed by VBN (Rg) 3 yield gap II as 421 kg, this shows if it was maintained well it gives more yields. The Figs. 8, 9, 10 and 11 representing the Yield Gap I and II of Red Gram were given in Annexure.

In this analysis of yield gap between the Ground nut varieties the variety VRI 5 shows very less difference 900 kg between them, this shows if it was maintained well it gives more yields. Among the varieties taken, variety VRI 8 shows high yield gap II (2970 kg) and variety TMV 13 shows less yield gap II (1910 kg). The Figs. 12, 13, 14 and 15 representing the Yield Gap I and II of Ground nut were given in Annexure.

In this analysis of yield gap I between the Sugar cane varieties the variety SI 8 shows very less difference between them, this shows if it was maintained well it gives more yields also the yield

Table 1. Yield gap analysis of paddy

Variety	Potential Yield (in kg)	Adaptive Research Trail Yield (in kg)	Farm Average Yield (in kg)	Yield Gap I (in kg)	Yield Gap II (in kg)
CO 51	12500	10655	4434	1845	6221
ADT 50	12000	10494	4295	1506	6199
ADT 49	10000	6175	3840	3825	2335
CO 4	85000	7348	3416	77652	3932

Table 2. Yield gap analysis of Ragi

Variety	Potential Yield (in kg)	Adaptive Research Trail Yield (in kg)	Farm Average Yield (in kg)	Yield Gap I (in kg)	Yield Gap II (in kg)
CO 15	7500	6775	2435	725	4340
CO 14	6000	3070	2040	2930	1030
CO 9	6000	4500	2400	1500	2100

Table 3. Yield gap analysis of red gram

Variety	Potential Yield (in kg)	Adaptive Research Trail Yield (in kg)	Farm Average Yield (in kg)	Yield Gap I (in kg)	Yield Gap II (in kg)
VBN 1	2000	1128	650	872	478
APK 1	1800	1128	628	672	500
CO (Rg) 7	1800	867	480	933	387
VBN (Rg) 3	2100	885	464	1215	421

Table 4. Yield gap analysis of ground nut

Variety	Potential Yield (in kg)	Adaptive Research Trail Yield (in kg)	Farm Average Yield (in kg)	Yield Gap I (in kg)	Yield Gap II (in kg)
TMV 13	6500	4550	2640	1950	1910
VRI 8	6750	5170	2200	1580	2970
VRI 6	6500	5200	2403	1300	2797
VRI 5	6000	5100	2384	900	2716

Table 5. Yield gap analysis of sugarcane

Variety	Potential Yield (in kg)	Adaptive Research Trail Yield (in kg)	Farm Average Yield (in kg)	Yield Gap I (in kg)	Yield Gap II (in kg)
SI 8	200000	187000	146000	13000	41000
SI 7	210000	168000	156000	42000	12000
COC (Sc) 24	240000	226000	133000	14000	93000

difference of gap II shows very less in SI 7 variety. The Figs 16, 17 and 18 representing the Yield Gap I and II of sugarcane were given in Annexure.

3.1 Strategies for Minimizing the Yield Gaps

- **Promotion of integrated crop management:** An integrated crop management (1CM) practices can effectively resolve yield gaps caused by biological, socio-economic and institutional constraints. “Timely planting, irrigation, weeding, and timely harvesting could account for more than 20 per cent yield increase” [5].
- **Adequate input and loan supplies:** Inputs play a major role in crop production and reduce the differences in yield. Farmers need sufficient quantities of quality inputs to get high yields at the right time. But resource limited productive farmers representing more than 80 per cent of the farm population are typically unable to buy the necessary quantities of inputs for better yield applications. Thus, these farmers must be assisted by sufficient and timely credit supply to narrow gaps in yield.
- **Research and extension support:** The researcher should understand the limitations of farmers on high productivity and therefore establish an integrated technological package for farmers (appropriate variety, timely planting, fertilizer, irrigation and pest management) for specific locations to bridge gaps. At the same time the extension service should ensures that the farmers apply the proposed accurately and efficiently the proposed technology packages in fields by efficient training, demonstrations, field visits, monitoring, etc.
- **Policy support:** Hanson et al. [6] recommended that “the government find solutions to socio-economic and political questions for narrowing the agronomic gap between farmers’ fields and the research stations”.

4. CONCLUSION

The technology advancement in agriculture increases continuously especially in crop

improvement. The technology development rate is 2 per cent and farm productivity rate only increase by 0.3 per cent in major crops. In several countries around the world, cultivation differences exist between potential and actual farmers yields are still relatively high due to the combination of constraints, such as poor management and farmers' economic conditions and lack of money, in particular Government credit and awareness and involvement. Therefore efforts should be made to reduce and raise the yield gaps and sustain crop production and productivity by resolving the limitations.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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ANNEXURE

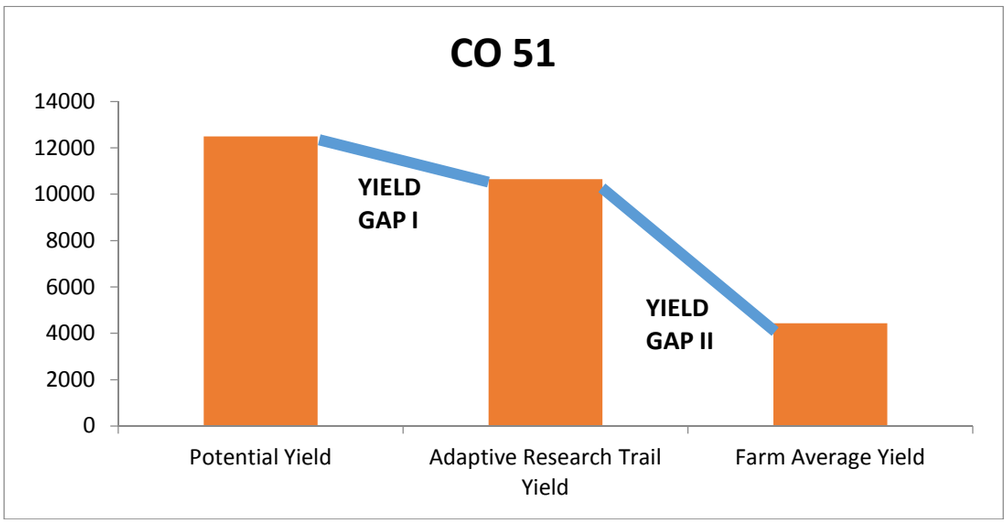

Fig. 1. Yield gap of paddy variety CO 51

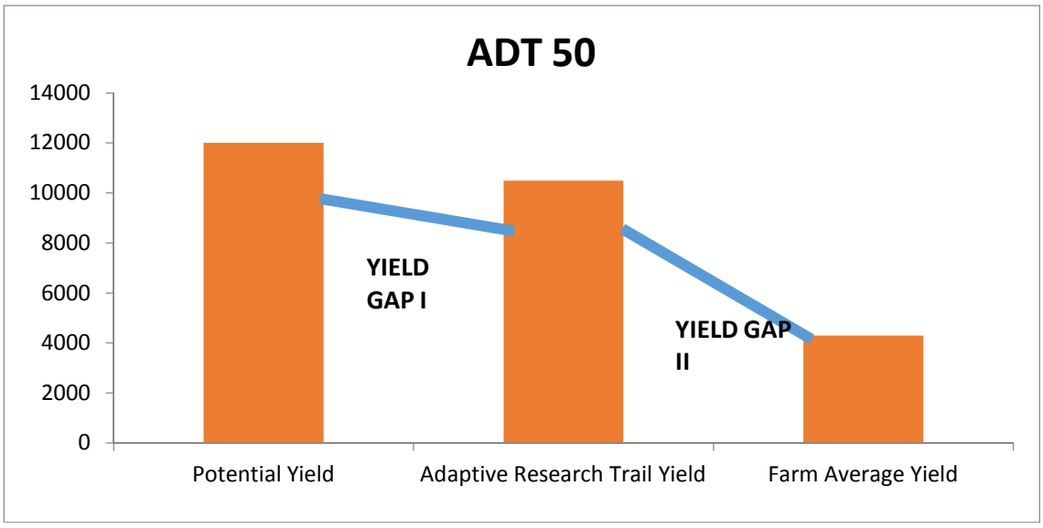

Fig. 2. Yield Gap of Paddy variety ADT 50

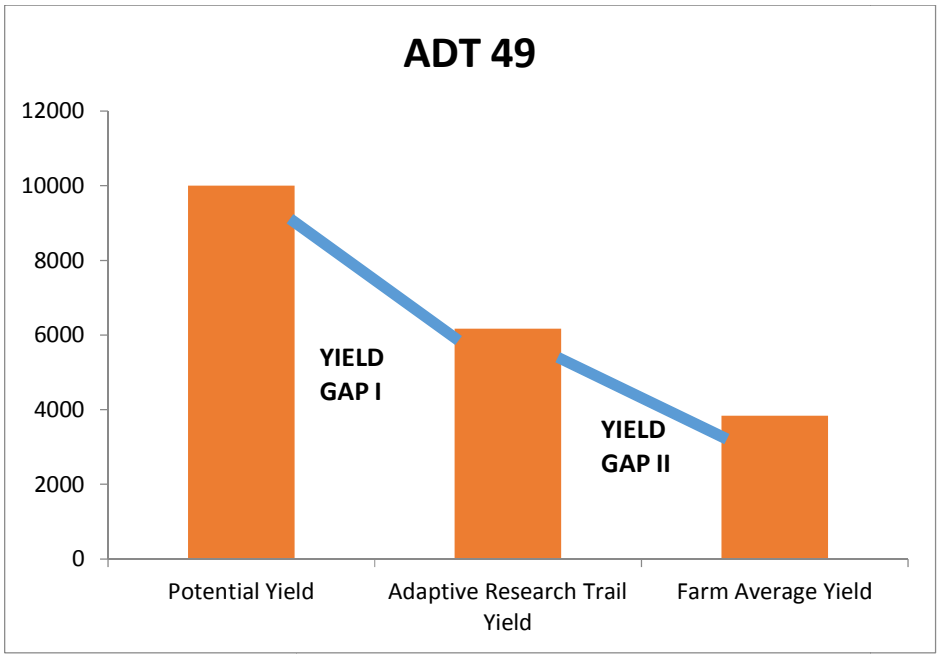

Fig. 3. Yield gap of paddy variety ADT 49

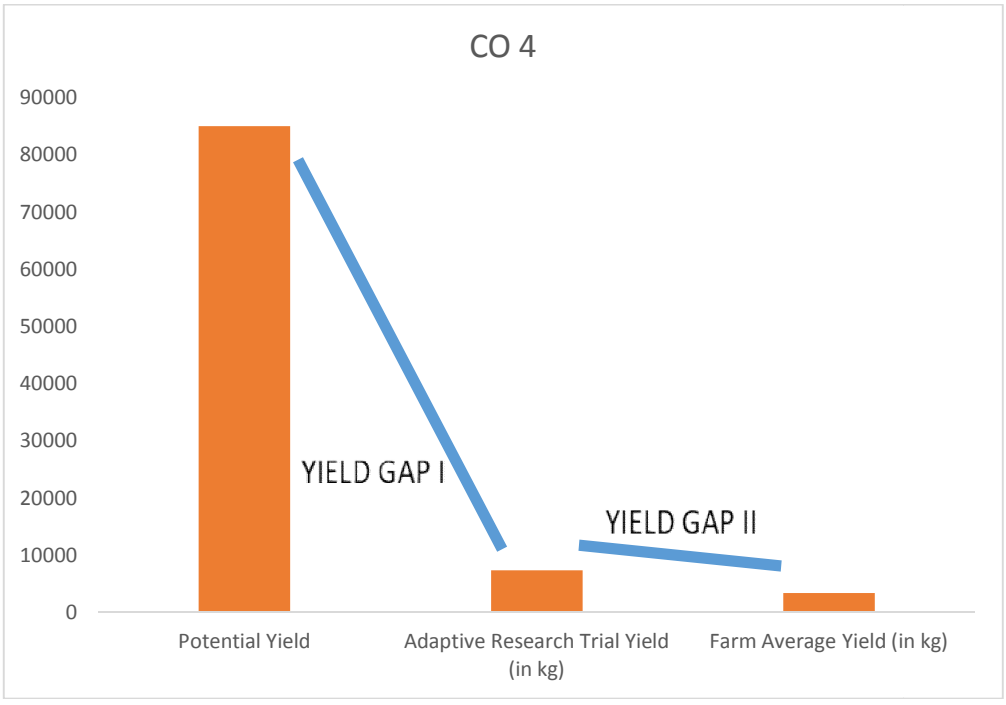

Fig. 4. Yield gap of paddy variety CO 49

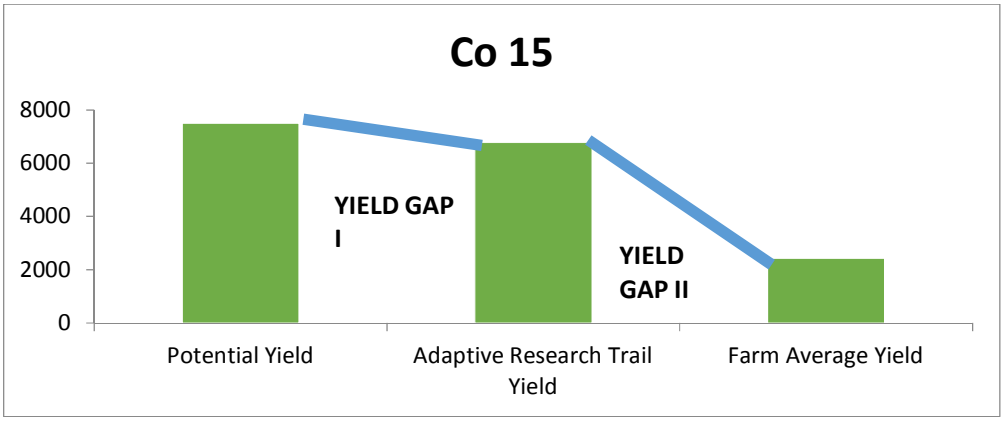

Fig. 5. Yield gap of Ragi variety CO 15

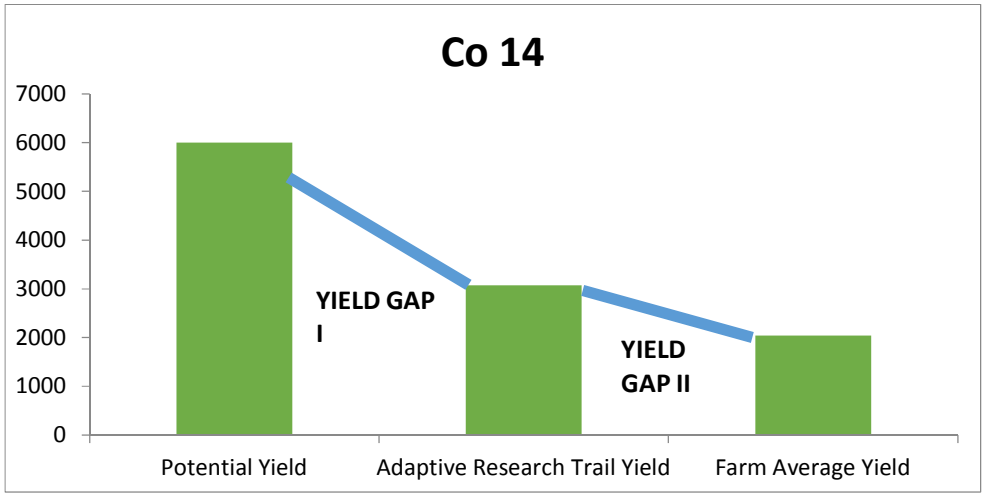

Fig. 6. Yield gap of Ragi variety CO 14

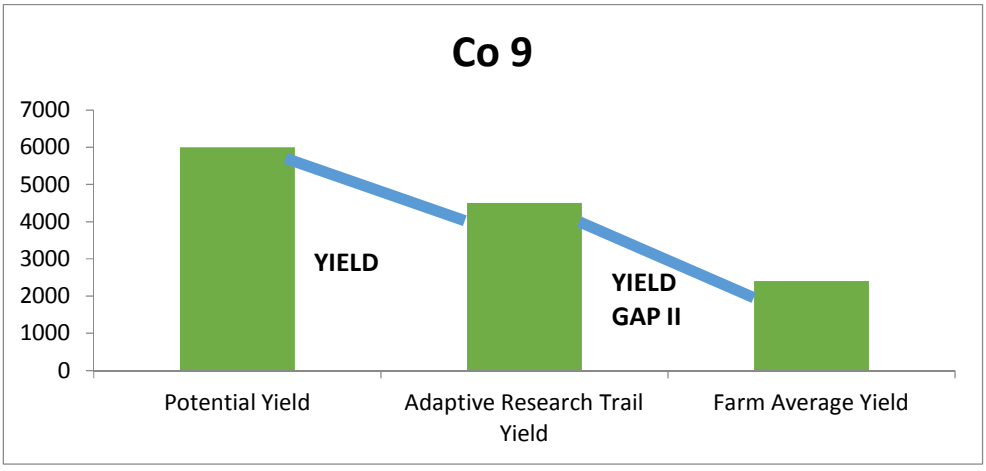

Fig. 7. Yield gap of Ragi variety CO 9

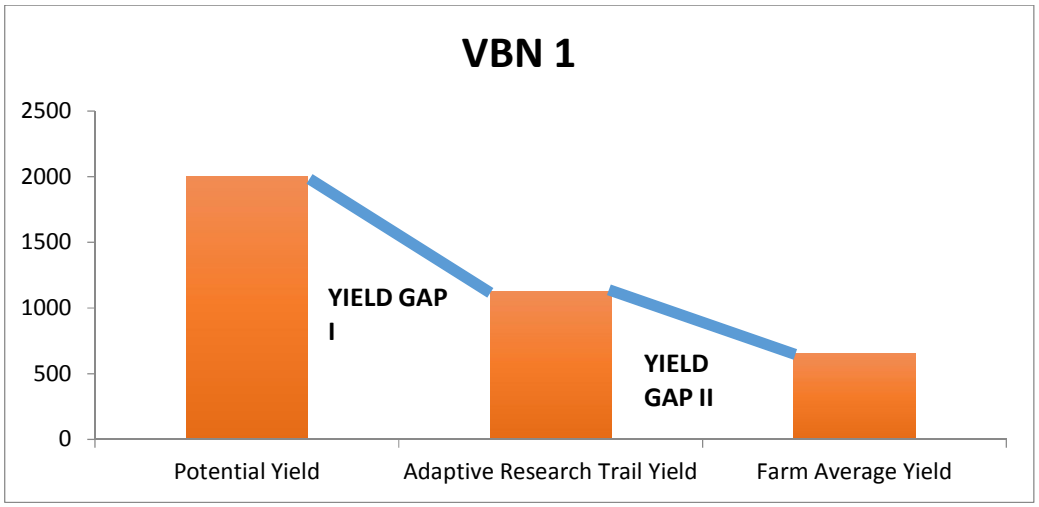

Fig. 8. Yield gap of red gram variety VBN 1

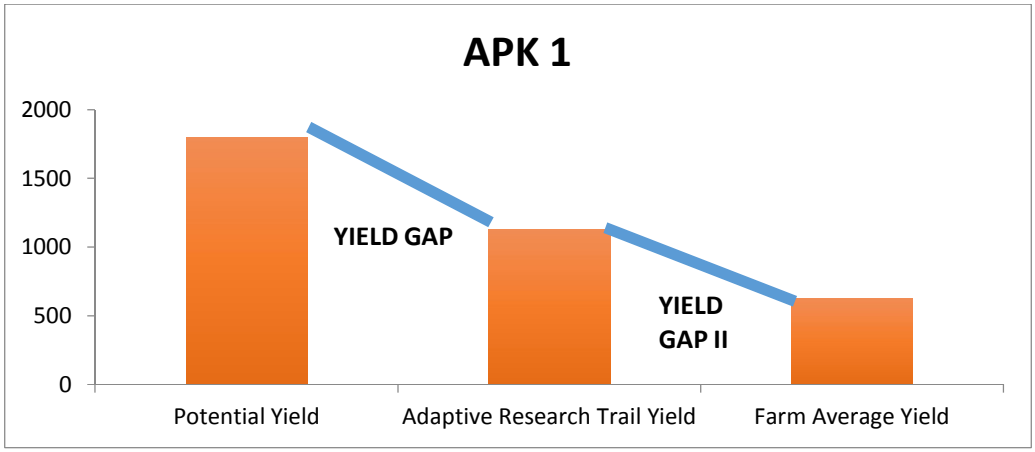

Fig. 9. Yield gap of red gram variety APK 1

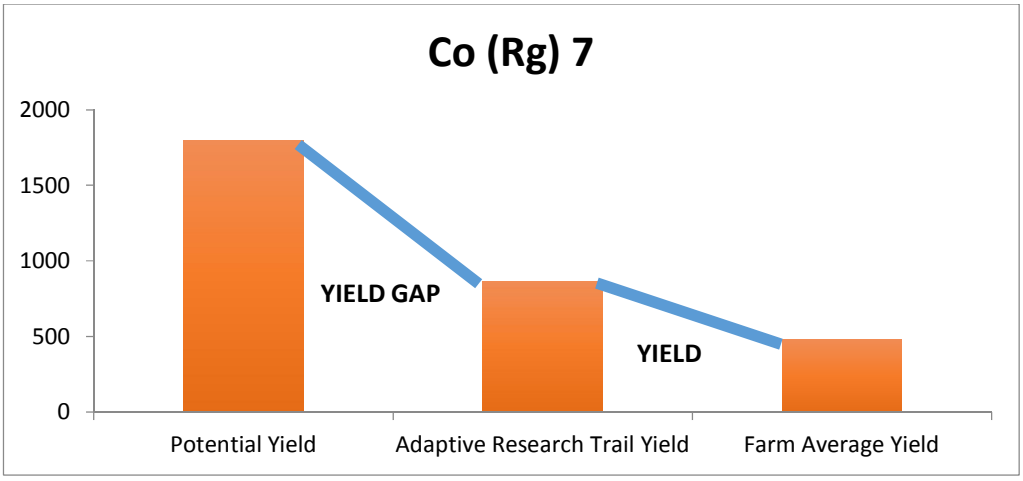

Fig. 10. Yield gap of red gram variety CO (Rg) 7

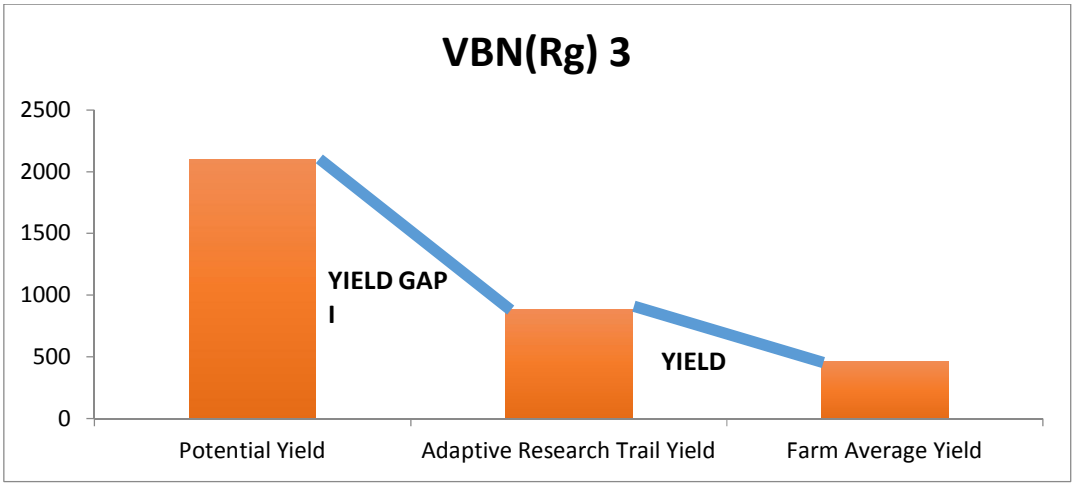

Fig. 11. Yield gap of red gram variety VBN (Rg) 3

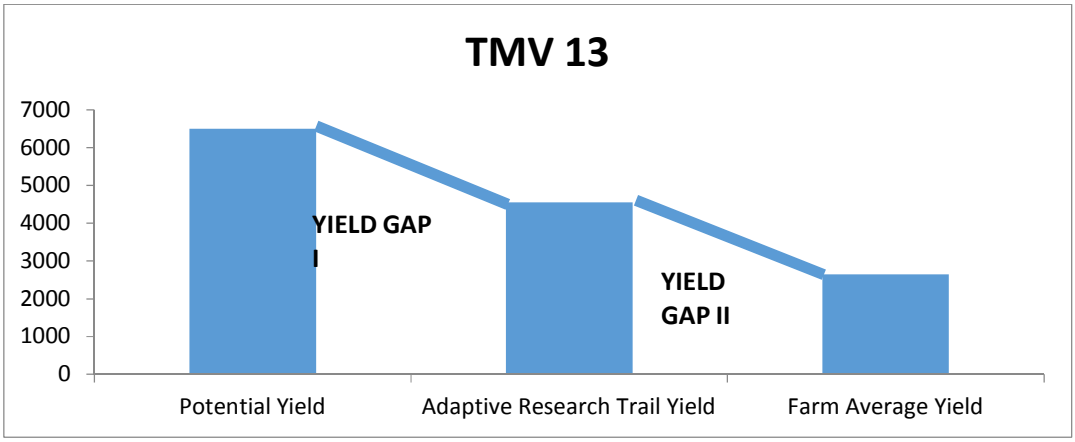

Fig. 12. Yield gap of Ground nut variety TMV 13

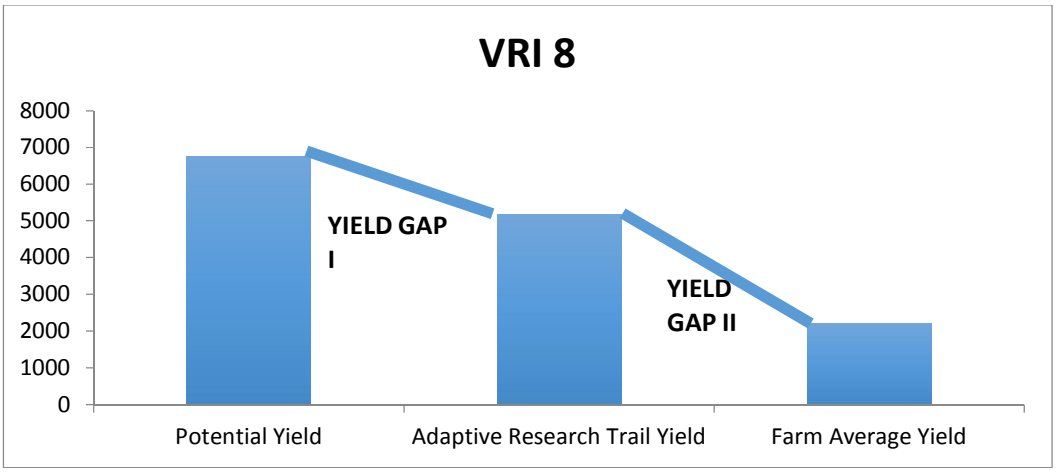

Fig. 13. Yield gap of ground nut variety VRI 8

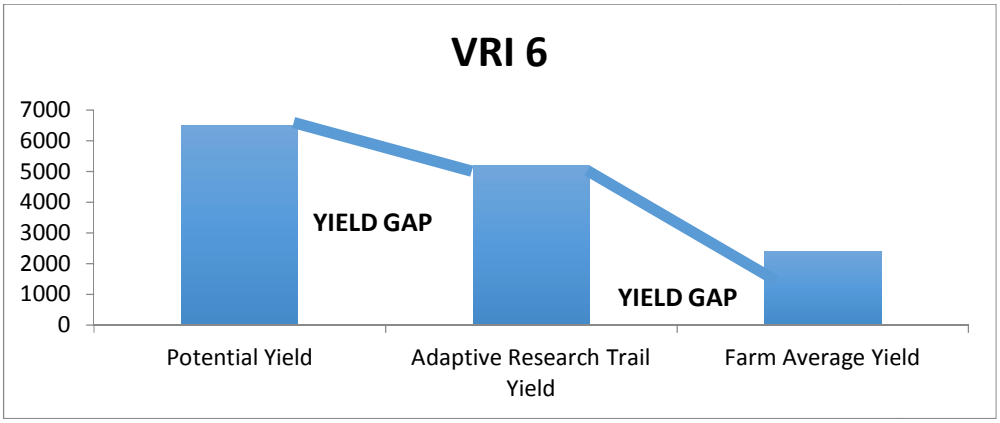

Fig. 14. Yield gap of ground nut variety VRI 6

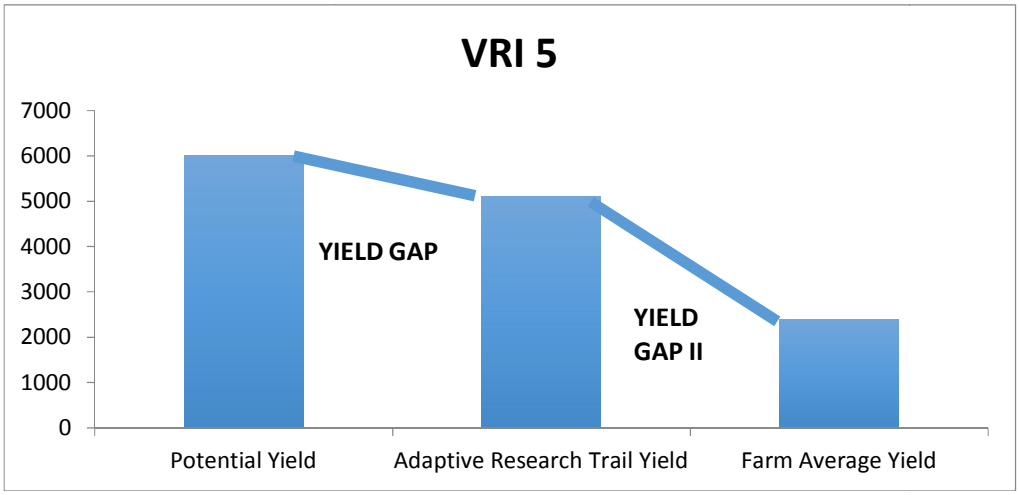

Fig. 15. Yield gap of ground nut variety VRI 5

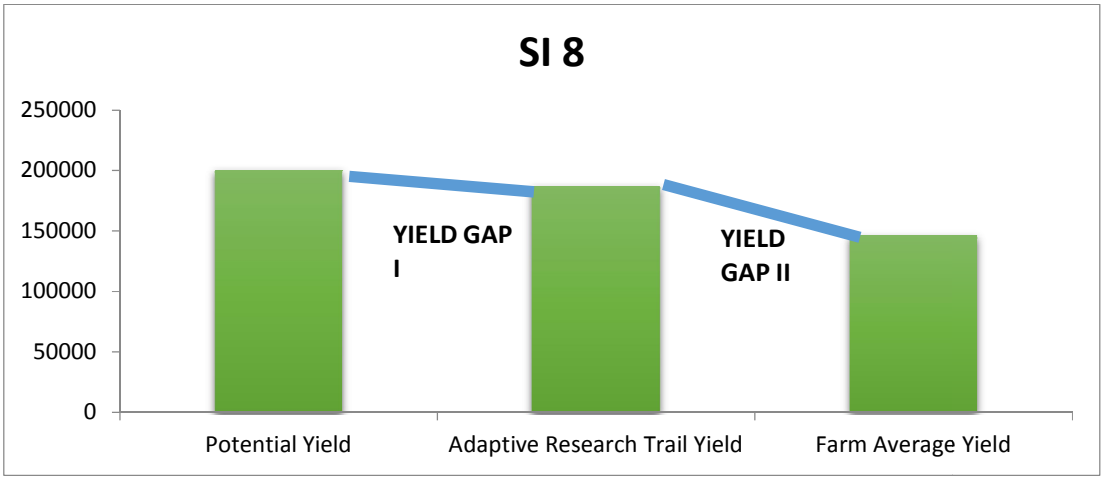

Fig. 16. Yield gap of sugar cane variety SI 8

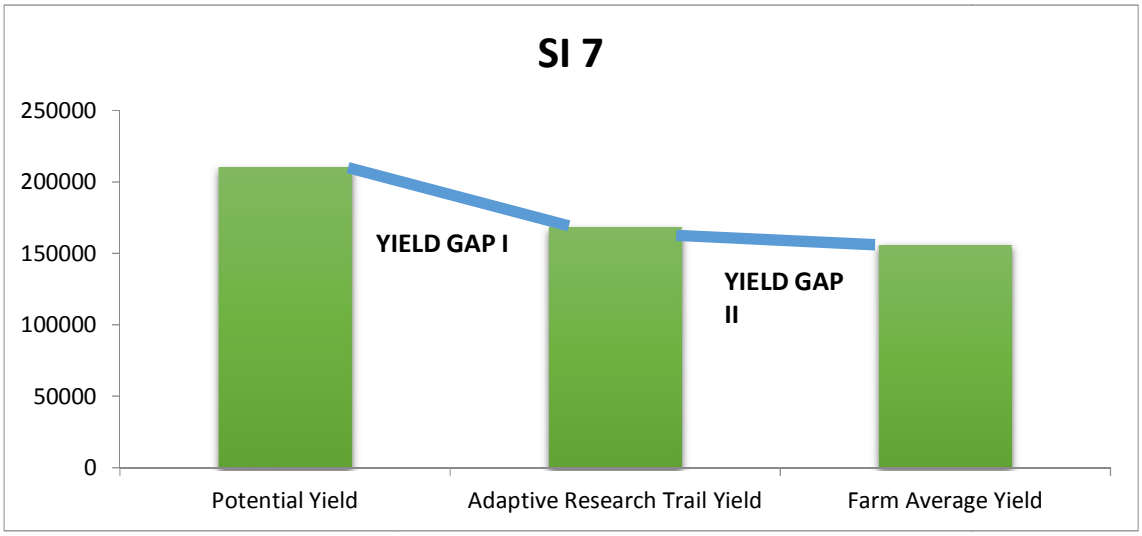

Fig. 17. Yield gap of sugar cane variety SI 7

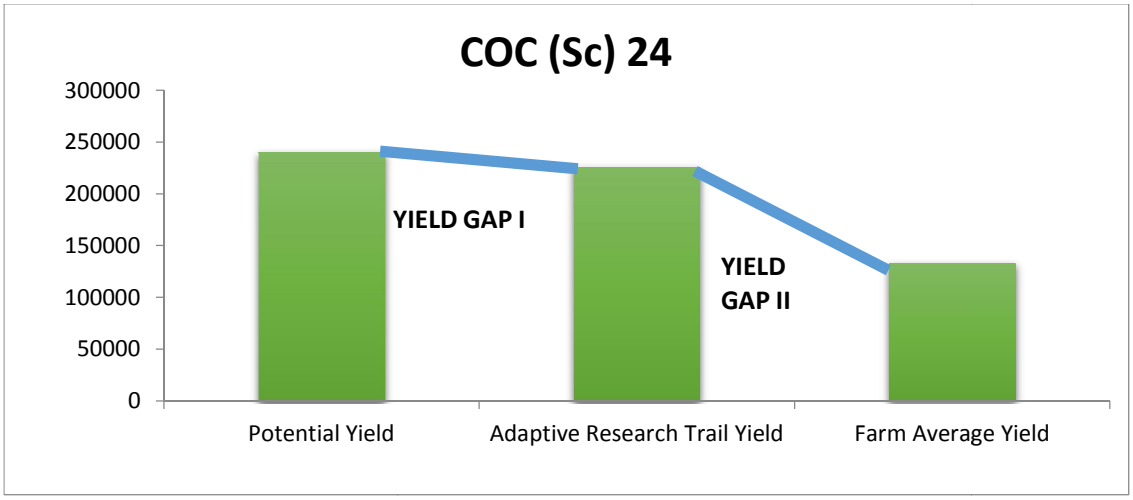

Fig. 18. Yield gap of sugar cane variety COC (Sc) 24

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