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Effect of biotic and abiotic factors on productivity of groundnut

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Abstract
This study was conducted on biotic and abiotic factors affecting the productivity of groundnut in Raigarh district of Chhattisgarh during the year 2021-2022. Groundnut productivity can be affected by a range of biotic and abiotic factors. Biotic factors refer to living organisms that can impact the growth and development of groundnut plants, while abiotic factors refer to non-living environmental factors that can affect groundnut productivity. However, it could be managed by adopting measures like, use of resistant cultivars, cultural, mechanical, biological and chemical. Total area of Raigarh is 16,800 ha, production of groundnut was 22,580 MT and productivity was 1344 kg/ha. For this study total of 120 groundnut growers were considered as respondents. Majority of the respondents (41.67 per cent) had a land area of 1.01ha to 2.00 ha area under groundnut cultivation followed by an area of up to 1.0 ha. By 38.33 per cent of respondents. The maximum productivity 12.1 to 14 q/ha. Was obtained by 65 per cent respondents. Yield gap analysis revealed that the difference between experimental yield and farmer's yield and it was observed that the yield gap appeared to be higher than the difference between demonstration yield and farmer's yield. Production losses were more due to hailstorms and weeds. Majority of farmers obtained 12-14 (q/ha.) of productivity in groundnut cultivation.

Keywords: Biotic, abiotic, groundnut, yield loss, productivity

1. Introduction
Groundnut (*Arachis hypogea* L.) belongs to family Fabaceae or Leguminosae. It is a popular oilseed crop in tropical and subtropical areas around the world and native to South America. India holds second rank in groundnut production after China with 6,650 MT production as 13 percent of total global production. Major groundnut growing districts are Raigarh, Jaspur, Sarguja, Kabirdham etc. In Raigarh, Goundnut is grown in 16,800 ha area and with the production of 22,580 MT and productivity 1344 kg/ha. Groundnut productivity can be affected by a range of biotic and abiotic factors. Biotic factors refer to living organisms that can impact the growth and development of groundnut plants, while abiotic factors refer to non-living environmental factors that can affect groundnut productivity. However, it could be managed by adopting measures like, use of resistant cultivars, cultural, mechanical, biological and chemical. Considering all the biotic and abiotic factors that affect groundnut productivity, the objective of this is to determine the effect of biotic and abiotic factors on productivity of groundnut. The findings of the present study would be help to understand the biotic and abiotic factors associate with groundnut crop.

2. Materials and Methods
The present study was carried out in four Raigarh districts of Chhattisgarh There are total seven blocks in Raigarh district namely, Pusaur, Tamnar, Raigarh, Lailunga, Dharamjaigarh, Gharghoda and Kharsiya, out of which only two blocks i.e. Pusaur and Raigarh were selected purposively on the basis of the maximum area under groundnut crop. From each selected blocks four village were selected randomly, in this way (2x4=8) village were considered for the study. From the total groundnut growers of each selected village, 15 farmers were selected randomly as respondents for the study. Thus, in this way, a total of 120 farmers (8x15 = 120) were considered as respondents for collection of data. The average productivity (q/ha) of groundnut crop, as reported by respondents of the study area was recorded and presented in range and average. For analysis, the actual yield of the crop was utilized.

As regards to measuring the intensity and severity of each biotic and abiotic factor affecting the productivity (probability of occurrence, percent area affected, and yield reduction) perceptions of respondents in this regard during the last 10 years were taken into consideration. To determine the yield loss from each biotic and abiotic factors in the study area, the following formula was used as per the procedure followed by Pandey (2000) [9].

$$\text{Productivity (q/ha)} = \frac{\text{Total yield (q)}}{\text{Total area (ha)}} * 100$$

$$\text{Probability of occurrence of problem} = \frac{\text{Average occurrence of problem during last 10 years}}{10}$$

$$\text{Proportion of area affected (\%)} = \frac{\text{Average affected area (\%)}}{100}$$

$$\text{Production loss in affected area (kg/ha)} = \text{Average yield loss reported by the farmers during current year}$$

3. Results and Discussion

3.1 Area under groundnut cultivation

The data pertaining to total area under groundnut crop is presented in table 1. Majority of the respondents (41.67 per cent) had a land area of 1.01ha to 2.00 ha area under groundnut cultivation followed by an area of up to 1.0 ha. by 38.33 per cent of respondents.

Table 1: Distribution of the respondents according to their area under groundnut crop.

	(n=120)	
Area wise farmers	**Frequency**	**Percentage**
Up to 1.0 ha.	46	38.33
1.1 to 2.0 ha.	50	41.67
2.1 to 3.0 ha.	22	18.33
Above 3.0 ha.	2	1.67
Cropped area		
Total cropped area = 249.45		
Total area under groundnut = 160.27		
Percentage of groundnut area in total cropped area = 64.27		
Average groundnut cropped area / family = 1.34 ha.		

3.2 Productivity of groundnut

The findings towards the average productivity of groundnut varieties are presented in Table 2 and depicted in Fig 1 revealed that total area under groundnut cultivation was 160.27 hectare. The maximum productivity 12.1 to 14 q/ha was obtained by 65 per cent respondents, followed by above 14 q/ha. Was obtained by 19.17 per cent of respondents and up to 12 q/ha was obtained by 15.83 per cent of respondents. The data revealed that maximum productivity (14.13 q/ha) was obtained from K- 1812 and followed by TG-37A (12.85 q/ ha), Chhattisgarh mungfali -1 (12.60 q/ha), other desi varieties of groundnut (12.06 q/ha) and the least productivity were ICGV-00350 (11.93 q/ha). The total average productivity of groundnut was 13.05 q/ha.

Table 2: Productivity of groundnut crop grown by the respondents.

			(n = 120)
S. No	**Productivity (q/ha.)**	**Frequency**	**Percentage**
1.	Up to 12 (q/ha.)	19	15.83
2.	12.1 to 14 (q/ha.)	78	65.00
3.	Above 14 (q/ha.)	23	19.17
Average productivity (q/ha.) = 13.05			

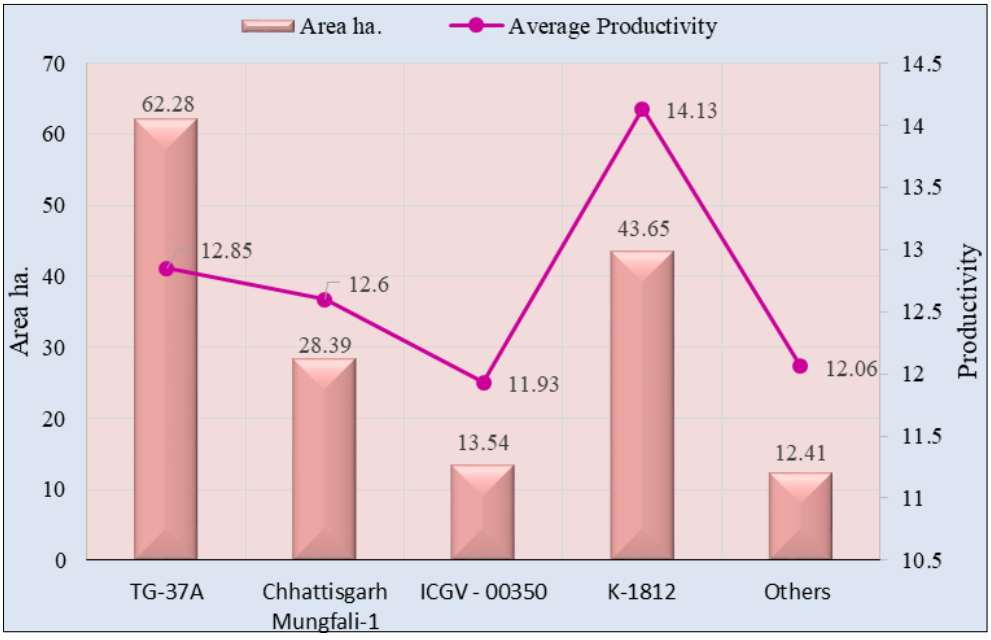

Fig 1: Productivity status of different groundnut varieties cultivated by the respondents

3.3 The yield loss caused by various biotic and abiotic factors

There are so many factors that affects the plant growth and crop yield in different ways like weeds, insects-pests and diseases which reduce the productivity. A pest causes damage to crops by feeding and attacking which later start puncturing the developing pod thereby causing heavy damage. Weeds also reduce the crop productivity by competing with the main crop for nutrients. Similarly, abiotic factors like high temperature, heavy and uncertainty rainfall, submergence, and salinity etc. and some other technological and social problems were also responsible for yield loss.

3.3.1 Assessment of yield gap

The data presented in Table 3 indicate that experimental yield is the yield obtained by the researchers on the research stations, while the demonstration yield is the yield obtained by the farmers on their field following the recommendations and under supervision of the scientists. The yield gap - I is the gap between the experimental yield and the demonstration yield. This yield gap is bound to happen and not much could be done to reduce this gap.

Table 3: Yield gap in groundnut cultivation in Raigarh district

Particulars	Yield (q ha$^{-1)}$	
	Rabi Groundnut	Kharif Groundnut
Average Experimental Yield	30	25
Average Demonstration Yield	17	15
Average Farmers' Yield	13	10.5
Yield Gap - I	13	10
Yield Gap - II	4	4.5
Source: AICRP on Groundnut, CARS, Raigarh		

Average farmers' yield is the average yield what an average farmer obtains from his field in the area. The yield gap – II is the gap between the demonstration yield and the farmers' yield. This gap is the attainable gap because the similar farmer has obtained the demonstration yield; the difference is between the adoption of technology, supply of inputs and management of crop. The yield gap - II is the attainable yield gap and the target of an extension worker is to minimize this gap and to attain the maximum possible yield on the farmers' field. The higher is the yield gap - II, the greater is the challenge before the extension personnel to bridge this gap. This higher yield gap - II shows the scope for the diffusion of the innovations and for the adoption of the improved recommended package of practices of the crop.

The data related to yield gap in groundnut cultivation in Raigarh district is presented in Table 3. In case of Rabi groundnut, the experimental yield was reported to be 30 q/ha$^{-1.}$ The demonstration yield was reported to be 17 q/ha$^{-1,}$ while the average farmers' yield of groundnut was 13 q/ha-1. Thus, the yield gap I was 13 q, while the yield gap II was 4 q/ha$^{-1.}$

The experimental yield of kharif groundnut was reported to be 25q ha^{-1}, while demonstration yield was reported to be 15 q/ha^{-1}. The farmers' yield came out to only 10.5 q ha^{-1}. The yield gap –I was 10 q/ha^{-1}, while yield gap – II was 4.5 q ha^{-1}.

This 13 q/ha-1 of yield gap - I is the farmers' yield through the use of an improved recommended package of practices, such as choosing suitable land, following proper sowing times, using certified seeds of improved varieties, adhering to recommended seed rates, treating seeds, using recommended chemical fertiliser and organic manure, following manual and chemical weed control methods, adopting plant protection measures, etc.

It can be concluded that the yield gap I, was found to be comparatively more than yield gap II and unlike experimental yield, farmers yield was not fairly attainable due to absence of ideal condition for farming on the field level.

3.3.2 Yield losses in groundnut due to biotic, abiotic and other factors

There are various biotic, abiotic and other factors which are responsible for the yield losses in the groundnut. The overall yield losses due to various biotic and abiotic factors in groundnut are presented in Table 4 depicted in Fig. 2.

The data revealed that groundnut production loss (during last 10 years) was more pronounced due to hailstorm (52.50 kg ha-1). The production loss due to weeds, heavy rainfall, insects, social problems and diseases were 36.85, 27.20, 25.44, 24.91 and 23.96 kg ha^{-1} respectively. The other technological and other factors like submergence, soil problem high temperature etc. were also responsible for reducing the groundnut production up to 22.30 kg ha$^{-1.}$ The total average yield loss from biotic, abiotic, social, technological and other factors was 213.16 kg ha$^{-1.}$

Table 4: Estimates of yield losses in groundnut due to biotic, abiotic and other factors

Sr. No.	Problem	Probability of occurrence of problem	Proportion of area affected (%)	Production loss in affected area (kg ha^{-1})	Production loss per unit of area under crop during last 10 years (kg ha^{-1})
1.	Diseases	0.56	0.22	189	23.96
2.	Insects	0.57	0.19	225	25.44
3.	Weeds	0.89	0.21	191	36.85
4.	Heavy Rainfall	0.47	0.34	163	27.20
5.	Hailstorm	0.26	0.41	475	52.50
6.	Social problems	0.64	0.18	208	24.91
7.	Technological and other problem	0.53	0.21	193	22.30
Total					213.16 kg ha^{-1}

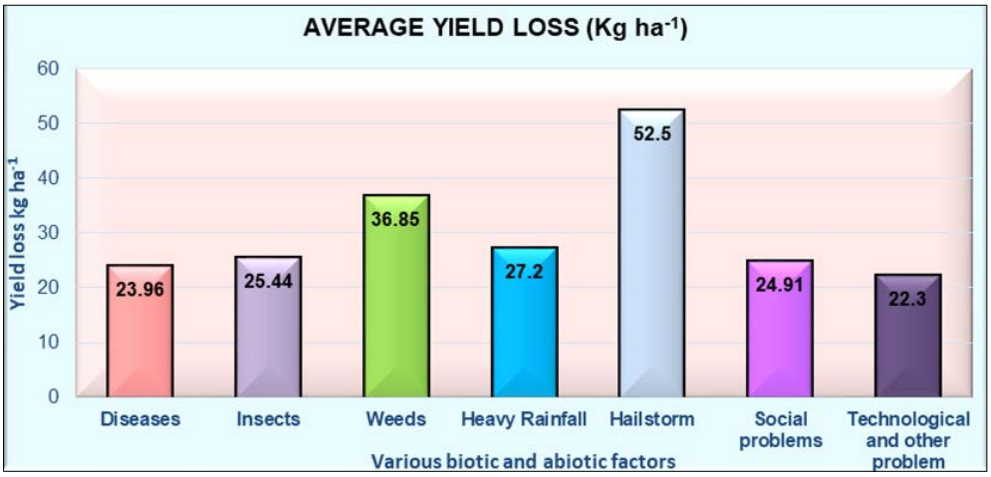

Fig 2: Yield loss in groundnut due to biotic, abiotic and other factors

4. Conclusion

Various conclusion drawn through above findings indicates that majority of the respondents (41.67 per cent) had a land area of 1.01ha to 2.00 ha. area under groundnut cultivation. Also, Majority of the respondents reported that groundnut was the main crop during the dry season for the commercial purpose. During wet season groundnut cultivation was done with the intention of producing seeds and family consumption of the respondents. While, majority of the respondents were used rental tube well for irrigation and majority of them had a land 1.01 to 2.00 ha. area under groundnut cultivation. The findings towards the average productivity of groundnut varieties, revealed that the maximum productivity (14.13 q/ha) was obtained from K- 1812 and followed by TG-37A (12.85 q/ ha), Chhattisgarh mungfali -1 (12.60 q/ha), other desi varieties of groundnut (12.06 q/ha) and the least productivity were ICGV-00350 (11.93 q/ha). The total average productivity of groundnut was 13.05 q/ha. Although there was slight difference in minimum and maximum productivity of different groundnut varieties but the average productivity was found at a par among different groundnut varieties.Regarding the yield losses caused due to these weeds, hailstorms, insects, disease and other technological factors that affect the productivity of groundnut.

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