STUDY ON VARIABILITY IN FIELD EXPERIMENTS ON ASHWAGANDHA CROP AND YARD STICK THERE OF

G.N. Motaka, V.B. Darji, D.J. Parmar, A.D. Kalola, and P.R. Vaishnav
Department of Agricultural Statistics
Anand Agricultural University, Anand-388 110, India

Abstract: The data on C.V. % for Ashwagandha crop yield along with other details of 106 field experiments conducted during 1989-90 to 2011-12 at Main Research Station, Medicinal and Aromatic crop, Anand Agricultural University, Anand were collected and analyzed. The frequency distribution tables were prepared for various experimental factors. The upper fiducial limits (the yardstick) of CV% at 95% confidence based on non central 't' distribution were worked out for accepting the results of Medicinal and aromatic crop experiments which emerged as 22 %.
Keywords: CV%, Fiducial limit, Plot size, Non central t distribution, Experimental variability.

INTODUCTION

In agricultural field experiments variation occurs due to uncontrolled factors such as soil fertility, climatic factors etc. and controlled factors such as field layout, treatments, replications, plot size etc. Such factors play an important role in the precision of the experimental results. C.V. % of the experiment is considered as a reliable index of variability for accepting or rejecting experimental results. Study on variability of large number of experiments help to develop the yardstick of CV% for field experiments. The present investigation was carried out with the objectives to study the experimental factors viz. disciplines, design, replications, treatments and plot sizes responsible for variability and to develop yardstick for reliability of the experimental results of Medicinal and aromatic crop experiments.

MATERIAL AND METHODS

The secondary data on C.V.% Ashwagandha crop yield of 106 field experiments conducted at Main Research Station, Medicinal and Aromatic crop, Anand Agricultural University, Anand during 1989-90 to 2011-12 in plant breeding, agronomy and plant protection disciplines on Ashwagandha crop was utilized for the variability study.

Information on plot size, number of treatments, replications, experimental design and disciplines was collected for each experiment. The data were analyzed to estimate error mean square and thereby C.V. % of each experiment (Snedecor and Chocran, 1967). Tyagi *et al* and Patel *et al* pointed out that C.V. obtained for the crops under study was found to be considerably higher than those reported from the uniformity trials. They stated that the yardstick for accepting experimental results should be worked out using C.V. observed in the experiments rather than in the uniformity trials. Bajpai and Nigam suggested a working rule for deciding the value of W_2 (weight corresponds to precision of the experiments) and developed an index to evaluate agricultural field experiments statistically. Gomez and Gomez reported that C.V. varies greatly with the type of experiment, the crop grown and the character measured. They pointed that the acceptable range of C.V. is 6% to 8% for varietal trial, 10 to 12 % for fertilizer trials and 13 to 15 % for insecticidal and herbicidal trials on rice. The upper fiducial limit of C.V. % at 95% confidence level based on non central 't' distribution (Johnson and Welch, 1939) was worked out on the basis of overall average C.V. % of 106 experiments in the present study, which was considered as yardstick of C.V. % for field experimentation on Ashwagandha crop at Anand.

RESULTS AND DISCUSSION

The results presented in Table 1 revealed that mean C.V. % (17.14) and upper fiducial limit (21.78) of average value of all the discipline except for plant breeding discipline, were below the mean C.V. %. The experiments on agronomy and plant protection showed large variation (average C.V. = 24.07 % and 22.58 %) respectively showed poor precision may be because of experimental requirements such as sample size, natural population of pests and diseases. Use of proper statistical tools may help to improve the precision of the results. More than 50% experiments of this disciplines had more than 22.65%.

Table 1: Upper fiducial limit of CV % for different disciplines of Ashwagandha crop

Discipline	No. of experiments	C.V. %	U L (0.05)	U L (0.10)	Range (0.05)	Range (0.10)	C.V. % > 21.78	
							No. of exp.	Proportion
Agronomy	50	18.95	24.07	22.78	5.13	3.83	15	0.30
Pl.Breeding	54	15.42	19.63	18.56	4.22	3.15	07	0.12
Pl.Protection	02	18.82	22.58	21.65	3.76	2.83	01	0.50
Mean	106	17.14	21.78	20.61	-	-	-	-

The results presented in Table 2 indicated that the experiments were carried out in RBD and FRBD design. Mean C.V. % (17.14) and upper fiducial limit (21.78) of average value of

all the design RBD design was below the mean C.V. %. The experiments in FRBD design showed large variation (average C.V. = 23.73 %) and about 37 % of them had C.V. % higher than the fiducial limit worked out.

Table 2: Upper fiducial limit of C.V. % for different design Ashwagandha crop

Design name	No.of experiment	C.V. %	U L (0.05)	U L (0.10)	Range (0.05)	Range (0.10)	C.V. % > 21.78	
							No. of exp.	Proportion
FRBD	29	19.61	23.73	22.73	4.13	3.12	11	0.37
RBD	77	16.22	21.05	19.81	4.63	3.59	12	0.15
Mean	106	17.14	21.78	20.61	-	-	-	-

Table 3: Upper fiducial limit of C.V. % for different treatments of Ashwagandha crop

Treatments	No. of experiment	C.V. %	U L	U L	Range	Range	C.V. % > 21.78	
			(0.05)	(0.10)	(0.05)	(0.10)	No. of exp.	Proportion
Upto 5	02	11.65	16.02	14.84	4.36	3.19	0	00
6-10	49	15.10	20.63	19.18	5.53	4.08	4	0.08
11-15	19	19.46	24.37	23.16	4.92	3.70	6	0.31
16-20	23	17.59	20.93	20.13	3.35	2.55	7	0.30
21-25	0	--	--	--	--	--	0	00
26-30	07	24.11	27.84	26.99	3.74	2.88	4	0.57
>30	06	18.57	21.13	20.55	2.56	1.99	2	0.33
Mean	106	17.14	21.78	20.61	-	-	-	-

The results presented in Table 3 revealed that experiments conducted with the set of treatments were within average fiducial limit of CV % except treatments 11-15 and 26 – 30.

Generally increased number of treatments in the experiments increases blocks (replication) size which increases error variance, affecting the precision of the results. Therefore, it is advisable to use such experimental designs (when treatment exceeds 26) which can help in controlling within block variation. Other means such as optimum plot size, more number of replications, proper site of the experiment etc. need to be considered. About 31 to 57 percent experiments showed higher C.V. % compared to the overall average C.V.% except the treatment group up to 5, 6-10, 16-20 and >30.

Table 4: Upper fiducial limit of C.V. % for different plot size of Ashwagandha crop

Plot size (m^2)	No. of experiment	C.V. %	U L (0.05)	U L (0.10)	Range (0.05)	Range (0.10)	C.V. % > 21.78 No.of exp.	Proportion
<3	06	23.96	27.76	26.89	3.80	2.93	03	0.50
3-6	30	16.34	21.58	20.22	5.24	3.89	04	0.13
6-9	19	14.77	19.34	18.17	4.58	3.40	03	0.15
9-12	51	17.71	22.11	21.01	4.40	3.30	13	0.25
Mean	106	17.14	21.78	20.61	-	-	-	-

The results indicated that the average C.V.% for different plot size experiments were below the average C.V.% (17.14) in plot size 3 to 9 sq.mt. Beyond 9 sq.mt. plot size the proportion of C.V.% having higher C.V.% increased from 0.25 to 1.0. Therefore, plot size of 3 to 9 sq.mt. seems to be an optimum plot size for ashwagandha crop. Therefore, this needs to be confirmed by plot technique study for different locations and crops.

As far as replications are concerned, the experiments conducted with 3 replications showed large variation and 27 per cent experiments showed CV > 21.78 (Table 5). Analysis showed that majority experiments were conducted with 3 and 4 replications in field experiments on ashwagandha crop in which about 27 percent were having C.V. % > 21.78.

Table 5: Upper fiducial limit of C.V. % for different replications of Ashwagandha crop

Replications	No. of experiment	C.V. %	U L (0.05)	U L (0.10)	Range (0.05)	Range (0.10)	C.V. % > 21.78 No. of exp.	Proportion
3	72	18.59	23.50	22.26	4.91	3.67	20	0.27
4	30	14.12	18.18	17.15	4.06	3.03	03	0.10
5	04	13.85	17.81	16.80	3.96	2.95	00	00
Mean	106	17.14	21.78	20.61	-	-	-	-

YARDSTICK OF C.V. % FOR ASHWAGANDHA CROP EXPERIMENTS

The C.V. % data of 106 field experiments were used to fit non central 't' distribution and to work out upper confidence limit of C.V. at 0.05 level of probability. According the upper fiducial limit of C.V. % at 95 percent confidence level of C.V. % was worked out to be 21.78 per cent. Thus the results suggested that about 22 per cent C.V. % should be considered as a yard stick for ashwagandha crop field experiments. These having C.V. % > 22 should be rejected for drawing scientific conclusion.

Table 6: The average upper fiducial limit and yardstick for CV % for the experiments of Ashwagandha crop

Name of Crop	No.of experiments	Mean C.V. %	Upper fiducial limit of C.V. %		Overall yardstick of C.V. %
			0.95	0.90	
Ashwagandha crop	106	17.14	21.78	20.61	22 %

Table 7: Power of F-test as influence by C.V. %

Class C.V. %	No. of experiments	F-test		
		Significant	Non-Significant	Ratio
3.35-8.35	5	1	4	4.00
8.35-13.35	43	8	35	4.38
13.35-18.35	27	7	20	2.83
18.35-23.35	10	1	9	9.00
23.35-28.35	9	2	7	3.50
28.35-33.35	4	2	2	1.00
33.35-38.35	3	1	2	2.00
38.35-43.35	4	1	3	3.00
43.35-48.35	0	0	0	00
48.35-53.35	1	0	1	00
>75	0	0	0	00
Total	106	23	83	3.61

The power of F test was examined with the non significant/ significant ratio of experiments (Table 7). The results revealed that the ratio consistently increased with the increase in C.V. of the experiments. It also indicated that the efficiency (of detecting difference in treatment means) of F-test decreased with the increase in C.V. of experiments. The average ratio was observed to be 3.61. The ratio for the class 13.35-18.35 % was almost equal to the average ratio which included 17.14 %, the mean C.V. of all experiments results clearly showed that when the coefficient of variation in ashwagandha crop field experiments exceeds 22 %, the experimental finding should not be considered for scientific purpose.

Acknowledgement

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