Original Research Article

Effect of potash application on incidence of bollworms in Bt cotton hybrid

Abstract:

This study evaluates the impact of different levels of potash (K2O) application on the incidence of bollworms in Bt cotton hybrid G. Cot. Hy. 8 BG II. A split-plot design field experiment was conducted at the Main Cotton Research Station, Surat, during Kharif 2018-2019. Treatments consisted of three levels of potash (0, 40, and 80 kg ha-1), potash mobilizing bacteria (KMB), and foliar sprays of potassium nitrate (KNO3). Results revealed that potash application significantly reduced pink bollworm (PBW) damage, with lower larval populations and flower damage in plots treated with higher potash levels. The findings suggest that potash application at optimal levels can effectively reduce bollworm incidence in Bt cotton hybrid.

Keywords:

Bt cotton, Bollworms, Potash (Murate of Potash), Potassium mobilizing bacteria, KNO3 (Potassium Nitrate)

Introduction:

Cotton (Gossypium spp.) plays a crucial role in the global textile industry and serves as a significant cash crop in many countries, including India. With the advent of Bt cotton, the incidence of bollworm pests, particularly pink bollworm (PBW), has been reduced due to the expression of Cry1Ac and Cry2Ab2 endotoxins. However, abiotic factors, such as nutrient management, have been found to influence pest incidence and gene expression. Potassium (K), an essential nutrient for cotton growth, plays a vital role in maintaining plant health and resistance to pest infestations. This study aims to investigate the effect of potash application on bollworm incidence in Bt cotton hybrid G. Cot. Hy. 8 BG II under field conditions.

Materials and Methods:

Study Area:

The field experiment was conducted at the Main Cotton Research Station, Surat (20º12' N latitude, 72º52' E longitude), during the Kharif season of 2018-2019. The area falls under the South Gujarat Medium Rainfall Agro Climatic Zone II.

Experimental Design:

The experiment followed a split-plot design with three replications. The treatments included:

- **Main plot treatments**: Potash (K2O) applications at three levels: 0, 40, and 80 kg ha-1.
- **Subplot treatments**: Potash mobilizing bacteria (KMB) at 0 and 2.5 L ha-1, and foliar sprays of potassium nitrate (KNO3) at 0 and 3% at squaring, flowering, and boll development stages.

Data Collection:

Bollworm incidence was monitored throughout the growing season. Pink bollworm (PBW), spotted bollworm (SBW), and American bollworm (ABW) were observed at different growth stages. Data on flower and boll damage were recorded. In addition, larval populations were counted at regular intervals.

Statistical Analysis:

The data were analyzed using ANOVA to determine the effects of potash application and interactions with KMB and foliar sprays on bollworm incidence and damage.

Results:

Effect of Potash on Pink Bollworm Incidence:

The application of potash (K2O) significantly reduced pink bollworm (PBW) damage. Plots receiving 80 kg ha-1 of K2O had the lowest flower damage (5.68% rosette flowers) compared to plots without K2O (9.83% rosette flowers). Larval populations were also significantly lower in plots treated with higher potash levels (2.48 larvae per 10 green bolls in 80 kg ha-1 plots) compared to control plots (3.71 larvae per 10 green bolls). Additionally, open boll damage was minimized with higher K2O applications.

Effect of Potash on Spotted and American Bollworm Incidence:

Spotted bollworm (SBW) and American bollworm (ABW) incidences were generally below the economic threshold level (ETL) throughout the crop period. Potash application slightly reduced the incidence of both SBW and ABW. Mean damage to green bolls by SBW was 1.61% in the 80 kg ha-1 K2O treatment, compared to 3.19% in the control.

Interaction of KMB and Potash:

The interaction between KMB and potash applications showed that KMB application enhanced the effect of potash in reducing PBW damage. However, the reduction in SBW and ABW incidence was not significantly influenced by KMB.

Seed Cotton Yield:

The highest yield (2692.90 kg/ha) was recorded in plots treated with 80 kg/ha of potash, followed by the 40 kg/ha treatment. KMB application marginally improved yields, but the interaction between treatments was not significant.

Discussion:

The results demonstrate that higher potash applications (80 kg ha-1) significantly reduced PBW damage in Bt cotton hybrid, as observed through reduced flower and boll damage and lower larval populations. This reduction in damage can be attributed to the role of potash in enhancing plant health and strengthening cell walls, making them less susceptible to bollworm attacks. The interaction between KMB and potash further supported the reduction in PBW incidence, though it did not significantly affect SBW and ABW populations. These findings suggest that nutrient management, particularly potash application, is crucial for effective bollworm management in Bt cotton.

Conclusion:

Potash application at 80 kg ha-1 significantly reduces the incidence of pink bollworm (PBW) in Bt cotton hybrid by decreasing flower and boll damage and larval populations. Potash supplementation, combined with KMB and foliar sprays, should be considered an integral part of pest management strategies for Bt cotton to optimize yield and minimize pest damage.

Declarations:

Ethics approval and consent to participate:

Not applicable.

Consent for publication:

The authors consent to the publication of this manuscript in the *International Journal of Environment and Climate Change*.

Availability of data and materials:

All data generated during this study are included in this published article.

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List 1 :Experimental Details

SI	Particulars		Detail
(i)	Location	:	Main Cotton Research Station, NAU, Surat
(ii)	Season and Year	:	*Kharif* 2018
(iii)	Crop and Variety	:	Cotton, G. Cot. Hy. 8 BG II
(iv)	Layout/Design	:	Split Plot Design (SPD)
(v)	Replications	:	3
(vi)	Spacing	:	1.20m x 0.45 m
(vii)	Plot Size	:	Gross: 6.00m x 5.40m Net: 3.60m x 4.50m
(viii)	Sowing date	:	Sowing: 27/06/2018 Re-sowing:17/07/2018
	Date of Gap filling	:	06/07/2018
	Date of 1st Picking	:	28/11/2018
	Date of Ring line Picking	:	01/12/2018
	Date of 2nd Picking	:	28/12/2018
(ix)	Manures and Fertilizers	:	FYM 10 t ha^{-1}&NPK:240:40:00 kg ha^{-1} (Recommended dose of nutrition) common to all the experimental unit
(x)	Cultural operations&Plant protection	:	Interculturing and weeding as and when requiredand ETL based sprays for sucking pests (as per Table 1)
(xi)	No. of Irrigations	:	One irrigation was given one month after cessation of rain (October)
(xii)	**Treatment Details**	:	
	Main Treatment	:	K_2O application as Murate of Potash (00:00:60), By Indian Potash Ltd. (Plate I)
	First level	:	K_0=0 kg ha^{-1}
	Second level	:	K_{40}= 40 kg ha^{-1}

	Third level	:	K_{80}= 80 kg ha^{-1}
	Sub Treatment 1	:	Potash Mobilizing Bacteria (Plate II)
	First level	:	B_0=No application of KMB
	Second level	:	B_1=KMB @2.5 lit ha^{-1}
	Sub Treatment 2	:	Foliar sprays of KNO_3(13:00:45)
	First level	:	NFS=No foliar spray of KNO_3
	Second level	:	FS=Foliar sprays of KNO_3 @3 % (Plate III)

(xiii)	**Treatment combinations : 12 (Twelve)**		
	TC1	:	No K_2O , No KMB, No foliar sprays of KNO_3
	TC2	:	No K_2O , No KMB, Foliar sprays of KNO_3
	TC3	:	No K_2O , KMB @2.5 l ha^{-1} , No foliar sprays of KNO_3
	TC4	:	No K_2O , KMB @2.5 l ha^{-1}, Foliar sprays of KNO_3
	TC5	:	K_2O @40 kg ha^{-1}, No KMB, No foliar sprays of KNO_3
	TC6	:	K_2O @40 kg ha^{-1}, No KMB, Foliar sprays of KNO_3
	TC7	:	K_2O @40 kg ha^{-1}, KMB @2.5 l ha^{-1} , No foliar sprays of KNO_3
	TC8	:	K_2O @40 kg ha^{-1}, KMB@2.5 l ha^{-1}, Foliar sprays of KNO_3
	TC9	:	K_2O @80 kg ha^{-1} , No KMB, No foliar sprays of KNO_3
	TC10	:	K_2O @80 kg ha^{-1}, No KMB, Foliar sprays of KNO_3
	TC11	:	K_2O @80 kg ha^{-1} , KMB @2.5 l ha^{-1}, No foliar sprays of KNO_3
	TC12	:	K_2O @80 kg ha^{-1} , KMB @2.5 l ha^{-1}, Foliar sprays of KNO_3

(xiv)	**Application of treatments:**
	The main and sub-treatment-1 were applied as basal application 15 days after germination of the crop in respective treatments. The sub-treatment-1 was prepared by thoroughly mixing the liquid potash Mobilizer after proper shaking in the compost and mixed well @2.5 lit 20 kg^{-1} of compost (Plate IV) and applied near the root zone at 30 DAS (Plate V). Whereas sub-treatment-2 was applied at squaring (60 DAS), flowering (75 DAS) and boll development (90 DAS) stages of the crop (Plate VI).

Plate I: Murate of Potash (K_2O) and its application as Main treatment

Plate II: NAUROJI Liquid Potash Mobilizing Bacteria (KMB)as sub-treatment

Plate III: Fully water soluble fertilizer, Potassium Nitrate (13:0:45 NPK) as sub treatment

Plate IV: Proper mixing of liquid Potash Mobilizing Bacteria (KMB) with compost before use

Plate V: Application of KMB near the root zone at (30 DAS)

Squaring (60DAS)

Flowering (75DAS)

Boll Development (90DAS)

PlateVI: Leaf sample collection in ice box at 45 DAS from experiment

Plate VII: Micro-centrifuge tubes (1.5 ml and 2.0 ml) used for dilution and extraction

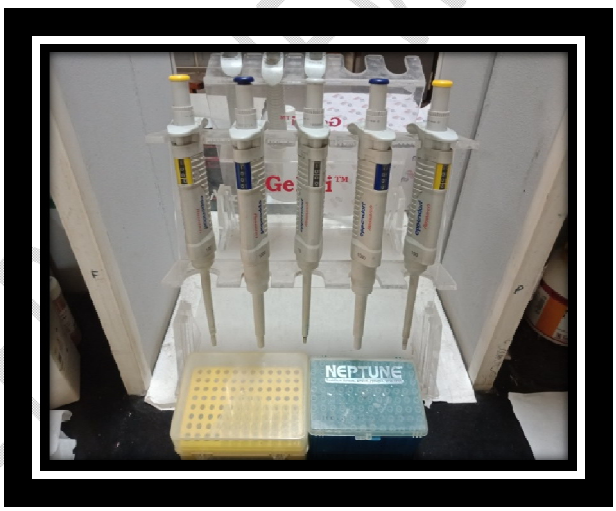

Plate VIII: Micro-pipettes to deliver accurate volume of liquid (10 to 1000µl)

PlateIX: Quantiplate™ *Cry1Ac* and *Cry2Ab2* ELISA kit

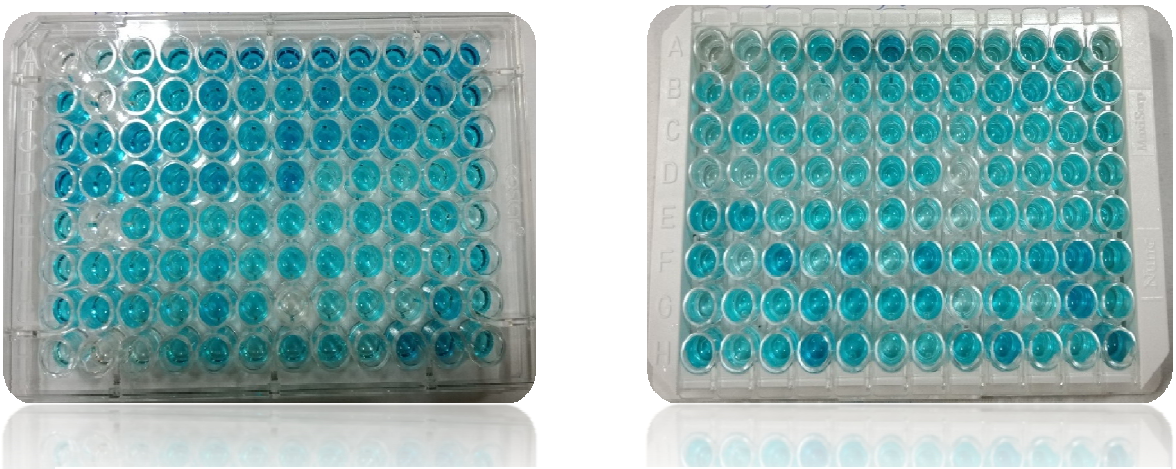

Plate X: Quantiplate™ *Cry1Ac* and *Cry2Ab2* ELISA kit

PlateXI: Tissue Lyser (For Crushing sample)

Plate XII: Centrifuge (for separation)

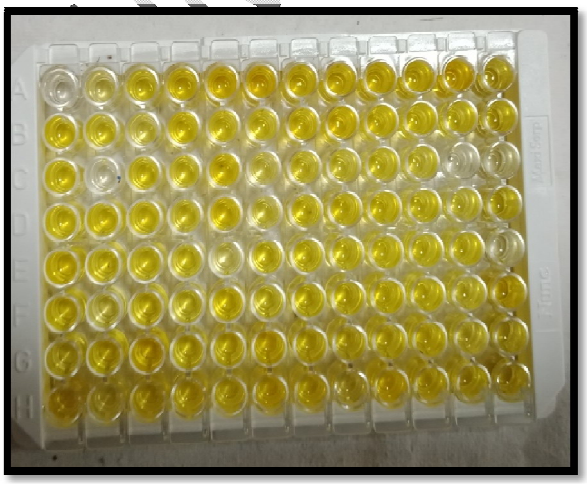

Plate XIII: Plate gaining yellow colour in the treated wells afteraddition

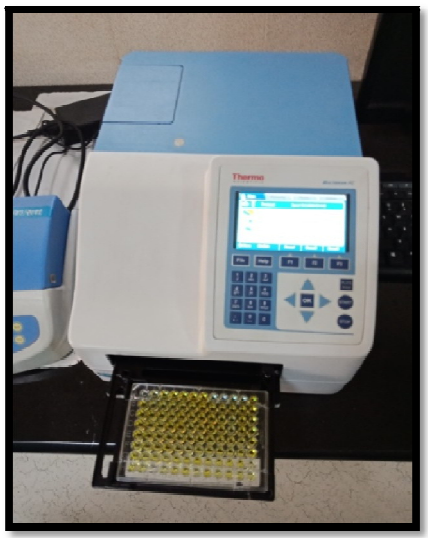

Plate XIV: ELISA Plate Reader for getting OD values of

Table 1: ETL based interventions against bollworms in different treatment combinations

Treatment combination	Sucking pests	Bollworms													Total no. of spray
		Pink bollworm				American bollworm					Spotted bollworm				
	Total No. of spray	Period of occurrence	DAS at which flower damage crossed ETL	DAS at which green boll damage crossed ETL	No. of spray	Period of occurrence	DAS at which larval population crossed ETL	DAS at which square damage crossed ETL	DAS at which green boll damage crossed ETL	No. of spray	Period of occurrence	DAS at which larval population crossed ETL	DAS at which square damage crossed ETL	DAS at which green boll damage crossed ETL	No. of spray	
K_0B_0NFS	4	75 to 165 DAS (first week of October to second week of January)	75, 105	105, 135	3	75 to 150 DAS (first week of October to last week of December)	-	-	-	0	75 to 150 DAS (first week of October to last week of December)	-	-	-	0	7
K_0B_0FS	4		75, 105	105, 135	3		-	-	-	0		-	-	-	0	7
K_0B_1NFS	4		75, 105	105, 135	3		-	-	-	0		-	-	-	0	7
K_0B_1FS	4		75, 105	105, 135	3		-	-	-	0		-	-	-	0	7
$K_{40}B_0NFS$	4		75	135	2		-	-	-	0		-	-	-	0	6
$K_{40}B_0FS$	3		75	-	1		-	-	-	0		-	-	-	0	4
$K_{40}B_1NFS$	4		75	135	2		-	-	-	0		-	-	-	0	6
$K_{40}B_1FS$	3		75	-	1		-	-	-	0		-	-	-	0	4
$K_{80}B_0NFS$	3		75	135	2		-	-	-	0		-	-	-	0	5
$K_{80}B_0FS$	2		75	-	1		-	-	-	0		-	-	-	0	3
$K_{80}B_1NFS$	3		75	135	2		-	-	-	0		-	-	-	0	5
$K_{80}B_1FS$	2		75	-	1		-	-	-	0		-	-	-	0	3

Note: Common insecticides sprays for PBW during 75 and 105 DAS based on ETL population and damage. K=K_2O , B=KMB , F=Foliar spray of KNO_3

Table 2: Damage of pink bollworm to flowers in different treatments on G. Cot. Hy. 8 BG II during 2018-19

Factors	% Rosette flower/5 Plants recorded at 15 days interval									
	75 DAS		90 DAS		105 DAS		120 DAS		Pooled	
	OV	TV	OV	TV	OV	TV	OV	TV	OV	TV
A. Main Treatment (Potash Fertilizer) K										
K_0	13.88	21.78	5.52	13.55	11.89	20.14	8.02	16.43	9.83	17.98
K_{40}	12.22	20.30	3.80	11.15	5.53	13.56	5.92	14.07	6.87	14.77
K_{80}	11.08	19.36	2.11	8.24	4.78	12.57	4.74	12.55	5.68	13.18
GM		**20.48**		**10.98**		**15.42**		**14.35**		**15.31**
SEm ±		1.07		0.14		0.12		0.10		**0.42**
CD (5%)		NS		0.58		0.48		0.41		**1.23**
CV %		18.12		4.67		2.75		2.50		**12.37**
B. Sub Treatment										
Potash Mobilizing Bacteria (B)										
B_0	12.46	20.53	4.41	11.97	7.87	16.00	6.33	14.48	7.77	15.75
B_1	12.33	20.43	3.20	10.00	6.92	14.84	6.12	14.22	7.14	14.87
GM		**20.48**		**10.99**		**15.42**		**14.35**		**15.31**
SEm ±		0.57		0.18		0.16		0.18		**0.14**
CD (5%)		NS		0.53		0.49		NS		**NS**
Foliar sprays of Potassium Nitrate (F)										
NFS	12.40	20.53	3.96	11.17	7.90	15.98	6.33	14.47	7.65	15.54
FS	12.39	20.43	3.66	10.79	6.89	14.86	6.12	14.23	7.26	15.08
GM		**20.48**		**10.98**		**15.42**		**14.35**		**15.31**
SEm ±		0.57		0.18		0.16		0.18		**0.14**
CD (5%)		NS		NS		0.49		NS		**NS**
Interactions	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**
KB	1.00	NS	0.31	NS	0.28	0.85	0.31	NS	0.27	**NS**
KF	1.00	NS	0.31	NS	0.28	NS	0.31	NS	0.27	**NS**
BF	0.81	NS	0.25	NS	0.23	NS	0.25	NS	0.23	**NS**
KBF	1.41	NS	0.44	NS	0.40	NS	0.44	NS	0.40	**NS**
PK									0.54	**NS**
PB									0.32	**NS**
PF									0.32	**NS**
PKBF									0.80	**NS**
CV%		11.99		7.00		4.57		5.36		**9.07**

Note: P=Period, NS=Non significant, TV= Transformed mean (Arc sine), OV= Original Values, GM=General Mean

Table 3: Incidence of pink bollworm larvae (small and big) on G. Cot. Hy. 8 BG II during 2018-19

Factors	Number of pink bollworm larvae (small and big)/10 green bolls recorded at 15 days interval									
	90 DAS		105 DAS		120 DAS		135 DAS		Pooled	
	OV	TV	OV	TV	OV	TV	OV	TV	OV	TV
A. Main Treatment (Potash Fertilizer) K										
K_0	1.16	1.70	1.50	2.21	1.33	1.90	1.25	2.29	1.31	2.02
K_{40}	0.91	1.62	1.41	1.84	1.08	1.74	1.16	1.99	1.14	1.62
K_{80}	0.83	1.46	1.16	1.71	1.08	1.74	1.00	1.88	1.02	1.46
GM		1.59		1.92		1.79		2.05		1.83
SEm ±		0.05		0.06		0.04		0.07		**0.03**
CD (5%)		NS		0.25		NS		0.29		**0.08**
CV %		12.02		11.40		9.22		12.79		**11.56**
B. Sub Treatments										
Potash Mobilizng Bacteria (B)										
B_0	2.28	1.65	3.44	1.97	3.05	1.87	4.11	2.12	3.22	1.90
B_1	1.89	1.53	3.11	1.87	2.50	1.72	3.61	1.98	2.78	1.78
GM		1.59		1.92		1.80		2.05		1.83
SEm ±		0.04		0.05		0.06		0.07		**0.03**
CD (5%)		NS		NS		NS		NS		**0.85**
Foliar sprays of Potassium Nitrate (F)										
NFS	2.22	1.64	3.39	1.95	3.00	1.86	4.61	2.24	3.31	1.92
FS	1.94	1.55	3.17	1.89	2.55	1.73	3.11	1.86	2.69	1.76
GM		1.59		1.92		1.79		2.05		1.83
SEm ±		0.04		0.05		0.06		0.07		**0.05**
CD (5%)		NS		NS		NS		0.21		**NS**
Interactions	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**
KB	0.07	NS	0.10	NS	0.11	NS	0.12	NS	0.05	**NS**
KF	0.07	NS	0.10	NS	0.11	NS	0.12	NS	0.05	**NS**
BF	0.06	NS	0.08	NS	0.09	NS	0.10	NS	0.04	**NS**
KBF	0.10	NS	0.14	NS	0.16	NS	0.18	NS	0.07	**NS**
PK									0.06	**NS**
PB									0.06	**NS**
PF									0.06	**0.17**
PKBF									0.15	**NS**
CV%		11.72		12.87		15.66		15.21		**14.18**

Note: P=Period, TV= Square root + 0.5 whereas, OV= Original Values, NS= Non-Significant, GM= General Mean

Table 4: Incidence of pink bollworm larvae (big) on G. Cot. Hy. 8 BG II during 2018-19

Factors	Number of pink bollworm larvae (big)/ 10 green bolls recorded at 15 days interval									
	90 DAS		105 DAS		120 DAS		135 DAS		Pooled	
	OV	TV	OV	TV	OV	TV	OV	TV	OV	TV
A. Main Treatment (Potash Fertilizer) K										
K_0	1.16	1.27	1.50	1.40	1.33	1.34	1.25	1.30	1.31	1.32
K_{40}	0.91	1.15	1.41	1.37	1.08	1.24	1.16	1.25	1.14	1.25
K_{80}	0.83	1.11	1.16	1.25	1.08	1.22	1.00	1.18	1.02	1.19
GM		**1.17**		**1.34**		**1.27**		**1.24**		**1.26**
SEm ±		0.05		0.03		0.07		0.09		**0.03**
CD (5%)		NS		NS		NS		NS		**0.08**
CV %		16.17		9.99		20.19		26.94		**19.16**
B. Sub Treatments										
Potash Mobilizng Bacteria (B)										
B_0	1.05	1.21	1.44	1.38	1.33	1.33	1.38	1.36	1.30	1.32
B_1	0.88	1.14	1.27	1.30	1.00	1.20	0.88	1.13	1.01	1.19
GM		**1.18**		**1.34**		**1.27**		**1.25**		**1.26**
SEm ±		0.07		0.05		0.05		0.06		**0.03**
CD (5%)		NS		NS		NS		0.18		**0.09**
Foliar sprays of Potassium Nitrate (F)										
NFS	1.05	1.21	1.38	1.35	1.22	1.29	1.27	1.30	1.23	1.29
FS	0.88	1.14	1.33	1.33	1.11	1.24	1.00	1.18	1.08	1.22
GM		**1.17**		**1.34**		**1.26**		**1.24**		**1.25**
SEm ±		0.07		0.05		0.05		0.06		**0.03**
CD (5%)		NS		NS		NS		NS		**NS**
Interactions	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**
KB	0.12	NS	0.10	NS	0.10	NS	0.11	NS	0.05	**NS**
KF	0.12	NS	0.10	NS	0.10	NS	0.11	NS	0.05	**NS**
BF	0.10	NS	0.08	NS	0.08	NS	0.09	NS	0.04	**NS**
KBF	0.18	NS	0.14	NS	0.14	NS	0.15	NS	0.07	**NS**
PK									0.06	**NS**
PB									0.06	**NS**
PF									0.06	**NS**
PKBF									0.15	**NS**
CV%		26.75		18.51		19.99		21.65		**21.69**

Note: P=Period, TV= Square root + 0.5 whereas, OV= Original Values, NS= Non-Significant, GM= General Mean

Table 5: Open bolls and locule damage by pink bollworm at harvest

Factors	Open bolls damage (%)		Locules damage (%)	
	OV	**TV**	**OV**	**TV**
A. Main Treatment (Potash Fertilizer) (K)				
K_0	15.01	22.73	9.93	18.33
K_{40}	12.77	20.83	8.15	16.51
K_{80}	9.01	17.22	5.09	12.93
GM		**20.26**		**15.92**
SEm ±		**1.02**		**0.68**
CD (5%)		**4.02**		**2.69**
CV %		**17.50**		**14.91**
B. Sub Treatment				
Potash Mobilizing Bacteria				
B_0	12.20	20.28	7.91	16.14
B_1	12.33	20.24	7.54	15.71
GM		**20.26**		**15.93**
SEm ±		**0.54**		**0.27**
CD (5%)		**NS**		**NS**
Foliar sprays of Potassium Nitrate (F)				
NFS	12.09	20.06	7.51	15.65
FS	12.43	20.46	7.94	16.20
GM		**20.26**		**15.93**
SEm ±		**0.54**		**0.27**
CD (5%)		**NS**		**NS**
Interactions				
	SEm ±	**CD (5%)**	**SEm ±**	**CD (5%)**
KB	0.94	NS	0.47	NS
KF	0.94	NS	0.47	NS
BF	0.77	NS	0.39	NS
KBF	1.33	NS	0.67	NS
CV%		**11.44**		**7.35**

Note: TV= Transformed mean (Arc sine) whereas, OV= Original Values, NS= Non- Significant, GM= General Mean

Table 6: Effect of potash application on damage to green bolls by pink bollworm										
Factors	**% Green boll damage recorded at 15 days interval**									
	90 DAS		**105 DAS**		**120 DAS**		**135 DAS**		**Pooled**	
	OV	**TV**	**OV**	**TV**	**OV**	**TV**	**OV**	**TV**	**OV**	**TV**
A. Main Treatment (Potash Fertilizer) K										
K_0	8.33	13.94	16.66	23.84	9.16	16.18	15.00	22.49	12.29	19.11
K_{40}	7.50	14.04	9.16	14.61	7.50	13.26	10.83	17.53	8.75	14.86
K_{80}	5.00	9.66	8.33	13.94	7.50	14.04	12.50	19.67	8.33	14.33
GM		**12.55**		**17.46**		**14.49**		**19.90**		**16.10**
SEm ±		2.63		2.95		3.74		3.20		**1.49**
CD (5%)		NS		NS		NS		NS		**NS**
CV %		72.65		58.69		89.43		55.71		**67.97**
B. Sub Treatment										
Potash Mobilizing Bacteria										
B_0	7.22	13.03	12.22	18.14	10.00	17.90	13.33	20.09	10.69	17.29
B_1	6.66	12.06	10.55	16.79	6.11	11.09	12.22	19.71	8.88	14.91
GM		**12.55**		**17.47**		**14.50**		**19.90**		**16.10**
SEm ±		2.47		2.45		1.74		1.44		**1.03**
CD (5%)		NS		NS		5.17		NS		**NS**
Foliar sprays of Potassium Nitrate										
NFS	8.88	15.43	12.22	18.14	8.88	15.95	13.88	21.58	10.97	17.78
FS	5.00	9.66	10.55	16.79	7.22	13.03	11.66	18.21	8.61	14.42
GM		**12.55**		**17.47**		**14.49**		**19.90**		**16.10**
SEm ±		2.47		2.45		1.74		1.44		**1.02**
CD (5%)		NS		NS		NS		NS		**2.89**
Interactions	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**
KB	4.28	NS	4.25	NS	3.01	NS	2.49	NS	1.73	**NS**
KF	4.28	NS	4.25	NS	3.01	NS	2.49	NS	1.75	**NS**

BF	3.49	NS	3.47	NS	2.46	NS	2.03	NS	1.44	**NS**
KBF	6.05	NS	6.01	NS	4.26	NS	3.53	NS	2.45	**NS**
PK									3.16	**NS**
PB									2.07	**NS**
PF									2.07	**NS**
PKBF									5.08	**NS**
CV%		83.54		59.62		50.98		30.75		**54.71**
Note: P=Period, NS= Non-Significant TV= Transformed mean (Arc sine) whereas, OV= Original Values and GM= General Mean										

Table 7: Incidence of larva of spotted bollworm in different treatments on G. Cot. Hy. 8 BG II during 2018-19

Factors	Av. number of larvae of Spotted bollworm/ 5 plants recorded at days after sowing																	
	113		120		127		134		141		148		155		162		Pooled	
	OV	TV	OV	TV	OV	TV	OV	TV	OV	TV	OV	TV	OV	TV	OV	TV	OV	TV
A. Main Treatment (Potash Fertilizer) K																		
K_0	0.50	0.96	0.66	1.03	0.41	0.90	0.41	0.90	1.08	1.20	1.75	1.48	2.25	1.64	2.33	1.67	1.17	1.22
K_{40}	0.16	0.79	0.91	1.15	0.33	0.87	0.25	0.83	0.50	0.96	0.33	0.87	0.25	0.83	1.08	1.22	0.47	0.94
K_{80}	0.00	0.70	0.25	0.83	0.00	0.70	0.00	0.70	0.00	0.70	0.08	0.75	0.16	0.79	0.00	0.70	0.06	0.73
GM		**0.82**		**1.01**		**0.83**		**0.81**		**0.95**		**1.03**		**1.03**		**1.09**		**0.97**
SEm ±		0.09		0.09		0.04		0.08		0.09		0.07		0.05		0.07		0.06
CD (5%)		NS		NS		0.15		NS		NS		0.28		0.23		0.29		0.20
CV %		41.97		33.42		16.81		37.18		35.36		24.55		18.82		21.48		28.97
B. Sub Treatment																		
Potash Mobilizing Bacteria (B)																		
B_0	0.22	0.82	0.55	0.96	0.33	0.87	0.27	0.84	0.38	0.90	0.66	1.01	0.94	1.12	1.22	1.23	0.57	0.97
B_1	0.22	0.82	0.66	1.05	0.16	0.79	0.16	0.79	0.66	1.00	0.77	1.06	0.83	1.05	1.05	1.17	0.56	0.97
GM		**0.82**		**1.01**		**0.83**		**0.82**		**0.95**		**1.04**		**1.09**		**1.20**		**0.97**
SEm ±		0.03		0.05		0.06		0.05		0.05		0.05		0.05		0.04		0.01
CD (5%)		NS		NS		NS		NS		NS		NS		NS		NS		NS
Foliar sprays of Potassium Nitrate (F)																		
NFS	0.16	0.79	0.55	0.98	0.33	0.87	0.27	0.84	0.44	0.91	0.77	1.06	0.94	1.11	1.16	1.21	0.58	0.97
FS	0.27	0.85	0.66	1.03	0.16	0.79	0.16	0.79	0.61	0.99	0.66	1.01	0.83	1.06	1.11	1.19	0.56	0.96
GM		**0.82**		**1.00**		**0.83**		**0.81**		**0.95**		**1.04**		**1.09**		**1.20**		**0.97**
SEm ±		0.03		0.05		0.06		0.05		0.05		0.05		0.05		0.04		0.01
CD (5%)		NS		NS		NS		NS		NS		NS		NS		NS		NS
Interactions	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**
KB	0.05	NS	0.08	NS	0.11	NS	0.09	NS	0.09	0.28	0.09	NS	0.08	NS	0.07	NS	0.03	NS
KF	0.05	NS	0.08	NS	0.11	NS	0.09	NS	0.09	NS	0.09	NS	0.08	NS	0.07	NS	0.03	NS
BF	0.04	NS	0.07	NS	0.09	NS	0.07	NS	0.07	NS	0.07	NS	0.07	NS	0.06	NS	0.02	NS
KBF	0.08	NS	0.12	NS	0.16	NS	0.13	NS	0.13	NS	0.13	NS	0.12	NS	0.10	NS	0.04	NS
PK																	0.08	0.23
PB																	0.05	NS
PF																	0.05	NS
PKBF																	0.12	NS
CV%		17.14		21.60		34.71		28.24		24.10		22.53		20.10		15.48		22.87

Note: P=Period, TV= Transformed mean (Arc sine) whereas, OV= Original Values and NS= Non-Significant, GM=General Mean

Table 8: Damage to square by spotted bollworm in different treatments on G. Cot. Hy. 8 BG II in 2018-19

Factors	% Square damage by SBW/ 5 Plants recorded at days after sowing																			
	75		82		89		96		102		109		116		123		130		Pooled	
	OV	TV	OV	TV	OV	TV	OV	TV	OV	TV	OV	TV	OV	TV	OV	TV	OV	TV	OV	TV
A. Main Treatment (Potash Fertilizer) (K)																				
K_0	1.16	6.06	2.02	8.13	3.61	10.89	3.97	11.46	4.30	11.94	3.25	10.34	3.05	10.02	2.91	9.80	3.27	10.34	3.06	9.89
K_{40}	0.24	2.27	0.30	2.77	0.80	4.90	0.72	4.66	0.94	5.46	1.61	7.18	2.00	8.05	2.47	9.00	2.66	9.37	1.30	5.96
K_{80}	0.24	2.27	0.27	2.38	0.33	3.15	0.58	4.27	0.72	4.75	0.91	5.44	1.05	5.84	1.28	6.26	1.55	7.09	0.77	4.61
GM		**3.53**		**4.43**		**6.31**		**6.80**		**7.38**		**7.66**		**7.97**		**8.35**		**8.93**		**6.82**
SEm ±		0.31		0.23		0.25		0.22		0.32		0.31		0.24		0.34		0.25		**0.41**
CD (5%)		1.21		0.90		1.00		0.88		1.25		1.22		0.97		1.34		1.00		**1.25**
CV %		30.38		18.06		13.92		11.46		15.01		14.07		10.73		14.17		9.92		**14.23**
B. Sub Treatment																				
Potash Mobilizing Bacteria (B)																				
B_0	0.57	3.59	1.00	4.93	1.70	6.73	1.85	7.04	1.99	7.52	2.09	8.05	2.05	8.03	2.38	8.72	2.50	8.98	1.79	**7.07**
B_1	0.53	3.48	0.73	3.93	1.46	5.89	1.66	6.55	1.98	7.24	1.75	7.26	2.01	7.91	2.05	7.99	2.49	8.89	1.63	**6.57**
GM		**3.54**		**4.43**		**6.31**		**6.80**		**7.38**		**7.66**		**7.97**		**8.36**		**8.94**		**6.82**
SEm ±		0.46		0.43		0.33		0.29		0.25		0.20		0.19		0.27		0.22		**0.10**
CD (5%)		NS		NS		NS		NS		NS		0.61		NS		NS		NS		**NS**
Foliar sprays of Potassium Nitrate (F)																				
NFS	0.57	3.74	0.88	4.49	1.61	6.42	1.86	7.02	1.99	7.45	1.97	7.85	2.14	8.23	2.31	8.58	2.46	8.89	1.76	**6.96**

FS	0.53	3.33	0.85	4.37	1.55	6.21	1.64	6.57	1.98	7.32	1.87	7.46	1.92	7.71	2.12	8.12	2.53	8.97	1.67	**6.67**
GM		**3.54**		**4.43**		**6.31**		**6.80**		**7.38**		**7.66**		**7.97**		**8.35**		**8.93**		**6.82**
SEm ±		0.46		0.43		0.33		0.29		0.25		0.20		0.19		0.27		0.22		**0.10**
CD (5%)		NS		NS		NS		NS		NS		NS		NS		NS		NS		**NS**
Interactions																				
	SE m ±	**CD (5 %)**	**SE m ±**	**CD (5 %)**	**SE m ±**	**CD (5 %)**	**SE m ±**	**CD (5 %)**	**SE m ±**	**CD (5 %)**	**SE m ±**	**CD (5 %)**	**SE m ±**	**CD (5 %)**	**SE m ±**	**CD (5 %)**	**SE m ±**	**CD (5 %)**	**SE m ±**	**CD (5 %)**
KB	0.81	NS	0.75	NS	0.57	NS	0.50	NS	0.44	NS	0.35	NS	0.33	NS	0.47	NS	0.39	NS	0.17	**NS**
KF	0.81	NS	0.75	NS	0.57	NS	0.50	NS	0.44	NS	0.35	NS	0.33	NS	0.47	NS	0.39	NS	0.17	**NS**
BF	0.66	NS	0.61	NS	0.46	NS	0.41	NS	0.36	NS	0.29	NS	0.27	NS	0.39	NS	0.32	0.95	0.14	**NS**
KBF	1.14	NS	1.06	NS	0.81	NS	0.72	NS	0.63	NS	0.50	NS	0.47	NS	0.67	NS	0.55	NS	0.24	**NS**
PK																			0.28	**0.80**
PB																			0.31	**NS**
PF																			0.31	**NS**
PKBF																			0.76	**NS**
CV%		56.26		41.71		22.28		18.36		14.91		11.45		10.38		14.03		10.76		**19.47**
Note: P=Period, TV= Transformed mean (Arc sine) whereas, OV= Original Values, NS= Non-Significant, General Mean																				

Table 9: Damage to green bolls by spotted bollworm in different treatments on G. Cot. Hy. 8 BG II during 2018-19

Factors	% Green boll damage/ 5 plants recorded at days after sowing											
	113		120		127		134		141		Pooled	
	OV	TV	OV	TV	OV	TV	OV	TV	OV	TV	OV	TV
A. Main Treatment (Potash Fertilizer) (K)												
K_0	3.30	10.40	3.19	10.22	3.36	10.51	3.77	11.16	2.33	8.21	3.19	10.10
K_{40}	1.08	5.68	1.44	6.86	2.24	8.43	1.61	7.17	0.80	4.82	1.43	6.59
K_{80}	0.36	3.00	0.80	5.03	0.63	4.47	0.64	4.43	0.28	2.35	0.54	3.86
GM		**6.36**		**7.37**		**7.80**		**7.59**		**5.13**		**6.85**
SEm ±		0.32		0.51		0.53		0.31		0.65		**0.23**
CD (5%)		1.26		2.01		2.11		1.25		2.55		**0.68**
CV %		17.58		24.10		23.86		14.56		44.01		**24.59**
B. Sub Treatment												
Potash Mobilizing Bacteria (B)												
B_0	1.64	6.48	1.92	7.64	2.11	7.98	2.07	7.78	1.44	5.92	1.83	7.16
B_1	1.51	6.24	1.70	7.10	2.05	7.64	1.94	7.39	0.83	4.03	1.61	6.54
GM		**6.36**		**7.37**		**7.80**		**7.59**		**5.13**		**6.85**
SEm ±		0.47		0.19		0.21		0.25		0.50		**0.16**
CD (5%)		NS		NS		NS		NS		1.49		**0.45**
Foliar sprays of Potassium Nitrate (F)												
NFS	1.64	6.59	1.94	7.65	2.16	8.04	2.05	7.75	1.48	5.96	1.85	7.20
FS	1.51	6.13	1.68	7.09	1.99	7.57	1.96	7.42	0.79	4.29	1.59	6.50
GM		**6.36**		**7.37**		**7.80**		**7.59**		**5.13**		**6.85**
SEm ±		0.47		0.19		0.21		0.25		0.50		**0.16**
CD (5%)		NS		NS		NS		NS		1.49		**0.45**
Interactions												
	SEm ±	**CD (5%)**	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**
KB	0.81	NS	0.34	NS	0.38	NS	0.44	NS	0.86	NS	0.27	**NS**
KF	0.81	NS	0.34	NS	0.38	1.13	0.44	NS	0.86	NS	0.27	**NS**
BF	0.66	NS	0.27	NS	0.31	NS	0.36	NS	0.70	NS	0.22	**NS**
KBF	1.15	NS	0.48	NS	0.53	1.60	0.62	NS	1.22	NS	0.38	**NS**
PK											0.48	**NS**
PB											0.35	**NS**

PF											0.35	**NS**
PKBF											0.86	**NS**
CV%		31.37		11.35		11.91		14.23		41.51		**21.89**
Note: P=Period, TV= Transformed mean (Arc sine) whereas, OV= Original Values, NS= Non-Significant, GM= General Mean												

Table 10: Open bolls and locules damage by spotted bollworm at harvest

Factors	Open bolls damage (%)		Locules damage (%)	
	OV	**TV**	**OV**	**TV**
A. Main Treatment (K)				
K_0	4.11	11.65	3.09	10.10
K_{40}	3.54	10.77	2.75	9.51
K_{80}	3.49	10.73	2.30	8.68
GM		**11.05**		**9.43**
SEm ±		**0.36**		**0.18**
CD (5%)		**NS**		**0.71**
CV %		**11.58**		**6.66**
B. Sub Treatment				
Potash Mobilizing Bacteria				
B_0	3.80	11.17	2.82	9.64
B_1	3.63	10.92	2.61	9.22
GM		**11.05**		**9.43**
SEm ±		**0.22**		**0.18**
CD (5%)		**NS**		**NS**
Foliar sprays of Potassium Nitrate (F)				
NFS	3.82	11.20	2.77	9.53
FS	3.61	10.89	2.66	9.33
GM		**11.05**		**9.43**
SEm ±		**0.22**		**0.18**
CD (5%)		**NS**		**NS**
Interactions				
	SEm ±	CD (5%)	SEm ±	CD (5%)
KB	0.39	NS	0.32	NS
KF	0.39	NS	0.32	NS
BF	0.32	NS	0.26	NS
KBF	0.56	NS	0.46	NS
CV%		**8.78**		**8.54**

Note: TV= Transformed mean (Arc sine) whereas, OV= Original Values, NS= Non-Significant, GM= General Mean

Table 11: Incidence of larva of American bollworm in different treatments on G. Cot. Hy. 8 BG II during 2018-19

Factors	Av. number of larvae of American bollworm/ 5 plants recorded at days after sowing																			
	106		113		120		127		134		141		148		155		162		Pooled	
	OV	TV	OV	TV	OV	TV	OV	TV	OV	TV	OV	TV	OV	TV	OV	TV	OV	TV	OV	TV
A. Main Treatment (Potash Fertilizer) K																				
K_0	0.83	1.09	0.83	1.08	0.75	1.08	1.25	1.27	2.00	1.56	1.41	1.34	1.08	1.24	0.33	0.87	1.00	1.19	1.05	1.19
K_{40}	0.16	0.79	0.08	0.75	0.08	0.75	0.25	0.83	0.33	0.87	0.16	0.79	0.25	0.83	0.17	0.79	0.08	0.75	0.17	0.79
K_{80}	0.00	0.70	0.00	0.70	0.00	0.70	0.00	0.70	0.00	0.70	0.08	0.75	0.00	0.70	0.00	0.70	0.00	0.70	0.01	0.71
GM		**0.86**		**0.84**		**0.84**		**0.93**		**1.05**		**0.96**		**0.92**		**0.79**		**0.88**		**0.90**
SEm ±		0.06		0.07		0.05		0.09		0.03		0.04		0.05		0.03		0.02		**0.03**
CD (5%)		0.26		0.28		0.23		0.37		0.15		0.18		0.20		0.11		0.10		**0.10**
CV %		27.28		29.20		23.99		35.42		12.78		17.38		19.17		13.32		10.91		**22.39**
B. Sub Treatment																				
Potash Mobilizing Bacteria (B)																				
B_0	0.38	0.89	0.33	0.86	0.38	0.89	0.55	0.96	0.83	1.06	0.55	0.95	0.44	0.93	0.16	0.79	0.33	0.87	0.44	0.91
B_1	0.27	0.83	0.27	0.83	0.16	0.79	0.44	0.91	0.72	1.03	0.55	0.96	0.44	0.91	0.16	0.79	0.38	0.89	0.38	0.88
GM		**0.86**		**0.85**		**0.84**		**0.94**		**1.05**		**0.96**		**0.92**		**0.79**		**0.88**		**0.90**
SEm ±		0.06		0.06		0.03		0.05		0.05		0.07		0.05		0.05		0.05		**0.01**
CD (5%)		NS		NS		NS		NS		NS		NS		NS		NS		NS		**NS**
Foliar sprays of Potassium Nitrate (F)																				
NFS	0.27	0.84	0.33	0.86	0.38	0.89	0.50	0.93	0.77	1.04	0.66	1.00	0.44	0.92	0.16	0.79	0.33	0.87	0.43	0.90
FS	0.38	0.89	0.27	0.83	0.16	0.79	0.50	0.93	0.77	1.05	0.44	0.91	0.44	0.92	0.16	0.79	0.38	0.89	0.39	0.89
GM		**0.86**		**0.84**		**0.84**		**0.93**		**1.04**		**0.95**		**0.92**		**0.79**		**0.88**		**0.90**
SEm ±		0.06		0.06		0.03		0.05		0.05		0.07		0.05		0.05		0.05		**0.01**
CD (5%)		NS		NS		NS		NS		NS		NS		NS		NS		NS		**NS**
Interactions	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**
KB	0.11	NS	0.11	NS	0.06	NS	0.09	NS	0.10	NS	0.12	NS	0.08	NS	0.09	NS	0.08	NS	**0.03**	**NS**
KF	0.11	NS	0.11	NS	0.06	NS	0.09	NS	0.10	NS	0.12	NS	0.08	NS	0.09	NS	0.08	NS	**0.03**	**NS**
BF	0.09	NS	0.09	NS	0.05	NS	0.07	NS	0.08	NS	0.10	NS	0.07	NS	0.07	NS	0.06	NS	**0.02**	**NS**
KBF	0.16	NS	0.16	NS	0.08	NS	0.12	NS	0.14	NS	0.17	NS	0.12	NS	0.13	NS	0.12	NS	**0.04**	**NS**
PK																			**0.05**	**0.16**
PB																			**0.05**	**NS**
PF																			**0.05**	**NS**
PKBF																			**0.14**	**NS**
CV%		32.88		33.59		18.30		23.80		24.06		31.99		23.24		29.45		23.51		**27.13**

Note: P=Period, TV= Transformed mean (Arc sine) whereas, OV= Original Values, NS= Non-Significant, GM= General Mean

Table 12: Damage to square by American bollworm in different treatments on G. Cot. Hy. 8 BG II in 2018-19

Factors	% Square damage by ABW/ 5 Plants recorded at days after sowing																			
	75		82		89		96		102		109		116		123		130		Pooled	
	OV	TV	OV	TV	OV	TV	OV	TV	OV	TV	OV	TV	OV	TV	OV	TV	OV	TV	OV	TV
A. Main Treatment (Potash Fertilizer) (K)																				
K_0	0.33	2.59	1.61	7.19	1.11	5.92	1.38	6.56	3.38	10.59	3.91	11.40	2.19	8.49	3.33	10.50	3.77	11.17	2.33	8.27
K_{40}	0.27	2.38	0.22	2.15	0.16	1.78	0.44	3.75	0.55	4.19	0.74	4.91	0.77	4.91	0.58	3.93	0.80	4.98	0.50	3.67
K_{80}	0.22	1.88	0.19	1.77	0.08	1.03	0.24	2.40	0.27	2.52	0.44	3.72	0.28	2.65	0.24	2.40	0.47	3.87	0.27	2.47
GM		**2.28**		**3.70**		**2.91**		**4.24**		**5.77**		**6.68**		**5.35**		**5.61**		**6.67**		**4.80**
SEm ±		0.31		0.32		0.39		0.28		0.12		0.22		0.43		0.40		0.30		**0.44**
CD (5%)		NS		1.28		1.53		1.12		0.48		0.87		1.69		1.60		1.19		**1.33**
CV %		48.30		30.52		46.44		23.30		7.38		11.58		27.90		25.23		15.79		**23.47**
B. Sub Treatment																				
Potash Mobilizing Bacteria (B)																				
B_0	0.33	2.64	0.72	3.83	0.48	3.15	0.77	4.42	1.44	6.02	1.77	6.85	1.10	5.48	1.40	5.67	1.88	7.08	1.10	5.02
B_1	0.22	1.93	0.62	3.57	0.42	2.67	0.60	4.05	1.36	5.51	1.62	6.50	1.05	5.22	1.36	5.56	1.47	6.27	0.97	4.59
GM		**2.29**		**3.70**		**2.91**		**4.24**		**5.77**		**6.68**		**5.35**		**5.62**		**6.68**		**4.81**
SEm ±		0.61		0.47		0.40		0.33		0.30		0.18		0.27		0.35		0.17		**0.12**
CD (5%)		NS		NS		NS		NS		NS		NS		NS		NS		0.52		**NS**
Foliar sprays of Potassium Nitrate (F)																				
NFS	0.3	2.48	0.7	3.80	0.4	3.00	0.7	4.50	1.4	6.00	1.7	6.72	1.1	5.74	1.4	6.07	1.7	6.85	1.0	5.02

	1				6		9		6		2		8		9		4		9	
FS	0.24	2.10	0.64	3.60	0.44	2.82	0.59	3.98	1.35	5.53	1.68	6.63	0.98	4.96	1.27	5.15	1.62	6.50	0.98	4.59
GM		**2.29**		**3.70**		**2.91**		**4.24**		**5.76**		**6.67**		**5.35**		**5.61**		**6.68**		**4.80**
SEm ±		0.61		0.47		0.40		0.33		0.30		0.18		0.27		0.35		0.17		**0.12**
CD (5%)		NS		NS		NS		NS		NS		NS		NS		NS		NS		**NS**
Interactions	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**
KB	1.06	NS	0.82	NS	0.69	NS	0.58	NS	0.53	NS	0.31	NS	0.48	NS	0.60	NS	0.30	NS	0.20	**NS**
KF	1.06	NS	0.82	NS	0.69	NS	0.58	NS	0.53	NS	0.31	NS	0.48	NS	0.60	NS	0.30	0.90	0.20	**NS**
BF	0.86	NS	0.67	NS	0.56	NS	0.47	NS	0.43	NS	0.25	NS	0.39	NS	0.49	NS	0.24	NS	0.17	**NS**
KBF	1.50	NS	1.17	NS	0.98	NS	0.82	NS	0.75	NS	0.44	NS	0.68	NS	0.86	NS	0.43	NS	0.29	**NS**
PK																			0.32	**0.93**
PB																			0.37	**NS**
PF																			0.37	**NS**
PKBF																			0.90	**NS**
CV%		113.48		54.81		58.18		33.71		22.64		11.48		22.07		26.55		11.21		**32.74**
Note: P=Period, TV= Transformed mean (Arc sine) whereas, OV= Original Values, NS= Non-Significant, GM= General Mean																				

Table 13: Damage to green bolls by American bollworm in different treatments on G. Cot. Hy. 8 BG II during 2018-19

Factors	% Green boll damage/ 5 plants recorded at days after sowing											
	113		120		127		134		141		Pooled	
	OV	TV	OV	TV	OV	TV	OV	TV	OV	TV	OV	TV
A. Main Treatment (Potash Fertilizer) (K)												
K_0	3.08	9.99	3.88	11.28	3.58	10.88	4.16	11.74	3.94	11.42	3.73	11.06
K_{40}	1.44	6.86	0.94	5.46	1.61	7.18	0.72	4.66	0.80	4.90	1.10	5.81
K_{80}	0.27	2.35	0.72	4.75	0.91	5.44	0.58	4.27	0.33	3.15	0.56	4.00
GM		**6.40**		**7.16**		**7.83**		**6.89**		**6.49**		**6.96**
SEm ±		0.55		0.39		0.24		0.30		0.14		**0.47**
CD (5%)		2.19		1.55		0.98		1.18		0.55		**1.56**

CV %		30.2		19.16		11.04		15.15		7.57		**17.84**
B. Sub Treatment												
Potash Mobilizing Bacteria (B)												
B_0	1.60	6.48	1.90	7.41	2.20	8.22	1.94	7.18	1.75	6.83	1.88	7.22
B_1	1.59	6.32	1.79	6.92	1.86	7.45	1.70	6.60	1.62	6.15	1.71	6.69
GM		**6.40**		**7.17**		**7.83**		**6.89**		**6.49**		**6.96**
SEm ±		0.36		0.32		0.17		0.28		0.29		**0.13**
CD (5%)		NS		NS		0.53		NS		NS		**0.36**
Foliar sprays of Potassium Nitrate (F)												
NFS	1.75	6.64	1.88	7.31	2.10	8.06	1.90	7.07	1.72	6.59	1.87	7.13
FS	1.44	6.16	1.81	7.03	1.96	7.61	1.73	6.71	1.66	6.39	1.72	6.78
GM		**6.4**		**7.17**		**9.15**		**6.89**		**6.49**		**6.96**
SEm ±		0.36		0.32		0.17		0.28		0.29		**0.12**
CD (5%)		NS		NS		NS		NS		NS		**NS**
Interactions												
	SEm ±	**CD (5%)**	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**	**SEm ±**	**CD (5%)**
KB	0.62	NS	0.55	NS	0.31	NS	0.49	NS	0.50	NS	0.22	**NS**
KF	0.62	NS	0.55	NS	0.31	NS	0.49	NS	0.50	NS	0.22	**NS**
BF	0.51	NS	0.45	NS	0.25	NS	0.40	NS	0.41	NS	0.18	**NS**
KBF	0.88	NS	0.78	NS	0.43	NS	0.70	NS	0.71	NS	0.32	**NS**
PK											0.35	**1.05**
PB											0.29	**NS**
PF											0.29	**NS**
PKBF											0.72	**NS**
CV%		23.99		18.96		9.71		17.65		19.10		**17.95**
Note: P=Period, TV= Transformed mean (Arc sine) whereas, OV= Original Values, NS= Non-Significant, GM= General Mean												

Table 14: Open bolls and locules damage by American bollworm at harvest

Factors	Open bolls damage (%)		Locules damage (%)	
	OV	**TV**	**OV**	**TV**
A. Main Treatment (Potash Fertilizer) (K)				
K_0	3.88	11.31	3.06	10.05
K_{40}	3.02	9.94	2.38	8.85
K_{80}	2.61	9.27	2.23	8.54
GM		**10.17**		**9.15**
SEm ±		**0.29**		**0.18**
CD (5%)		**1.16**		**0.72**
CV %		**10.11**		**7.00**
B. Sub Treatment				
Potash Mobilizing Bacteria				
B_0	3.43	10.60	2.68	9.38
B_1	2.91	9.74	2.43	8.91
GM		**10.17**		**9.15**
SEm ±		**0.20**		**0.18**
CD (5%)		**0.60**		**NS**
Foliar sprays of Potassium Nitrate (F)				
NFS	3.28	10.35	2.61	9.22
FS	3.06	10.00	2.51	9.07
GM		**10.17**		**9.15**
SEm ±		**0.20**		**0.18**
CD (5%)		**NS**		**NS**
Interactions				
	SEm ±	**CD (5%)**	**SEm ±**	**CD (5%)**
KB	0.35	NS	0.31	NS
KF	0.35	NS	0.31	NS
BF	0.28	NS	0.25	NS
KBF	0.50	NS	0.44	NS
CV%		**8.55**		**8.43**

Note: TV= Transformed mean (Arc sine) whereas, OV= Original Values, NS= Non-Significant, GM= General Mean

Table 15: Boll worm incidence irrespective of main and sub treatments and their correlation with expression of *Cry1Ac* and *Cry2Ab* in boll rind

PBW larvae/10 green bolls			SBW larva/5 plants		ABW larva/5 plants		*Cry1Ac*/boll rind (µg g^{-1} of fresh tissue)			*Cry2Ab2*/boll rind (µg g^{-1} of fresh tissue)		
90 DAS	**105 DAS**	**120 DAS**	**111DAS**	**118 DAS**	**111DAS**	**118 DAS**	**90 DAS**	**105 DAS**	**120 DAS**	**90 DAS**	**105 DAS**	**120 DAS**
P1	**P2**	**P3**	**S1**	**S2**	**A1**	**A2**	**Y1**	**Y2**	**Y3**	**Y1**	**Y2**	**Y3**
2.08±0.51	3.28±0.92	2.78±0.52	0.22±0.26	0.61±0.34	0.31±.41	0.28±0.42	3.20±0.16	3.06±0.18	3.01±0.20	81.79±7.57	85.79±6.42	87.86±9.07
Correlation value												
P1							0.0111			-0.5929**		
	P2							0.0609			-0.2248	
		P3							-0.2216			-0.4555*
			S1					0.1030			-0.2313	
				S2					0.5315**			0.064
					A1			-0.2813			-0.2288	
						A2			0.0442			-0.5064**

Note: Table value at 5%=0.331 and at 1%=0.4266, *=Significant, **= Highly-significant

Table 16: Seed cotton yield as influenced by different treatment combinations

Factors	Seed cotton yield (kg ha^{-1})	
A. Main Treatment (K)		
K_0	2103.90	
K_{40}	2471.45	
K_{80}	2692.90	
GM	**2422.75**	
SEm ±	**67.55**	
CD (5%)	**265.19**	
CV %	**9.66**	
B. Sub Treatment I (B)		
Potash Mobilizing Bacteria		
B_0	2376.37	
B_1	2469.13	
GM	**2422.75**	
SEm ±	**28.93**	
CD (5%)	**85.95**	
Foliar sprays of Potassium Nitrate (F)		
NFS	2379.80	
FS	2465.70	
GM	**2422.75**	
SEm ±	**28.93**	
CD (5%)	**NS**	
Interactions		
	SEm±	**CD(5%)**
KB	50.10	NS
KF	50.10	NS
BF	40.91	NS
KBF	70.86	NS
CV%	**5.07**	

Table 17: Economics of main and sub-treatments

Treatment	Seed cotton yield (Kg/ha)	No. of spray		Total spray	Gross realization (Rs./ha)	Fixed cost	Variable cots						Total expenditure (Rs./ha)	Net realization (Rs./ha) (Rounding to near rupee)	BCR
						Cost of cultivation (Rs./ha) excluding picking and inputs (Fixed cost)	Treatment cost								
							Potassium and its application cost	Potash Mobilizing Bacteria and its application cost	Potassium Nitrate and its apllication cost	Insecticide and its application		Gross treatment cost			
		SP	BW							SP	BW				
A. Main Treatment (K)															
K_0	2103.91	4.00	3.00	7.00	94675.95	35000.00	0.00	315.50	3414.00	5111.00	3378.00	12218.50	47218.50	47457.00	2.01
K_{40}	2471.45	3.50	1.50	5.00	111215.25	35000.00	1623.00	315.50	3414.00	4278.00	2294.00	11924.50	46924.50	64290.00	2.37
K_{80}	2692.90	2.50	1.50	4.00	121180.61	35000.00	2889.00	315.50	3414.00	2579.50	2294.00	11492.00	46492.00	74688.00	2.61
B. Sub-treatment 1 (B)															
B_0	2376.37	3.33	2.00	5.33	106936.73	35000.00	1504.00	0.00	3414.00	3989.50	2655.33	11562.83	46562.83	60373.00	2.30
B_1	2469.14	3.33	2.00	5.33	111111.15	35000.00	1504.00	631.00	3414.00	3989.50	2655.33	12193.83	47193.83	63917.00	2.36
C. Sub-treatment 2 (F)															
NFS	2379.80	3.67	2.33	6.00	107091.08	35000.00	1504.00	315.50	0.00	4555.67	2864.00	9239.17	44239.17	62851.00	2.42
FS	2465.71	3.00	1.67	4.67	110956.80	35000.00	1504.00	315.50	6828.00	3423.33	2446.67	14517.50	49517.50	61439.00	2.24

Note: SP= Sucking pest, BW= Bollworm, BCR=Benefit Cost Ratio

Table 18: Economics of various treatment combinations at ETL based interventions

Treatment	Seed cotton yield (Kg/ha)	No. of Sprays		Total Spray	Gross realization (Rs./ha)	Fixed cost	Variable cost					Total expenditure (Rs./ha)	Net realization (Rs./ha) (Rounding to near rupee)	BCR
						Cost of cultivation (Rs./ha) excluding picking and inputs (Fixed cost)	Potassium and its application cost	Potash Mobilizing Bacteria and its application cost	Potassium Nitrate and its apllication cost	Insecticide and its application cost				
		SP	BW							SP	BW			
K_0B_0NFS	2047.33	4	3	7	92129.9	35000	0	0	0	5111	3378	43489	48641	2.12
K_0B_0FS	2119.34	4	3	7	95370.3	35000	0	0	6828	5111	3378	50317	45053	1.90
K_0B_1NFS	2088.48	4	3	7	93981.6	35000	0	631	0	5111	3378	44120	49862	2.13
K_0B_1FS	2160.49	4	3	7	97222.1	35000	0	631	6828	5111	3378	50948	46274	1.91
$K_{40}B_0NFS$	2272.63	4	2	6	102268.4	35000	1623	0	0	5111	2607	44341	57927	2.31
$K_{40}B_0FS$	2500.00	3	1	4	112500.0	35000	1623	0	6828	3445	1981	48877	63623	2.30
$K_{40}B_1NFS$	2489.71	4	2	6	112037.0	35000	1623	631	0	5111	2607	44972	67065	2.49
$K_{40}B_1FS$	2623.46	3	1	4	118055.7	35000	1623	631	6828	3445	1981	49508	68548	2.38
$K_{80}B_0NFS$	2705.76	3	2	5	121759.2	35000	2889	0	0	3445	2607	43941	77818	2.77
$K_{80}B_0FS$	2613.17	2	1	3	117592.7	35000	2889	0	6828	1714	1981	48412	69181	2.43
$K_{80}B_1NFS$	2674.90	3	2	5	120370.5	35000	2889	631	0	3445	2607	44572	75799	2.70
$K_{80}B_1FS$	2777.78	2	1	3	125000.1	35000	2889	631	6828	1714	1981	49043	75957	2.55

Note: Av. Seed cotton price Rs. 45 kg^{-1} during 2018-19 and labour charge @ Rs. 178/8 working hours day^{-1}, SP= Sucking pest, BW= Bollworm, K= K_2O levels , B= KMB application, F=foliar sprays of KNO_3, BCR=Benefit Cost Ratio

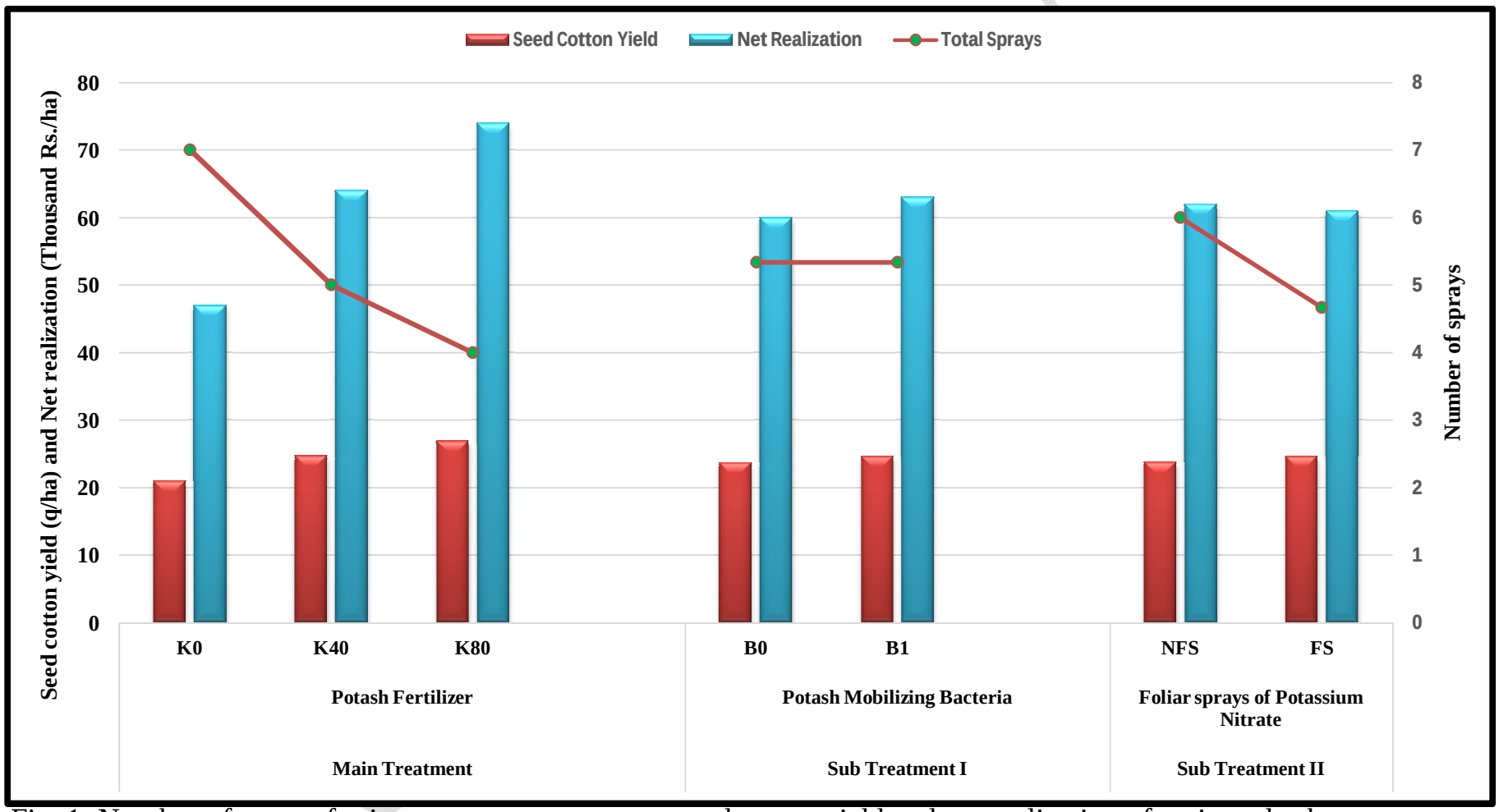

Fig. 1: Number of sprays for insect pest management, seed cotton yield and net realization of main and sub treatments

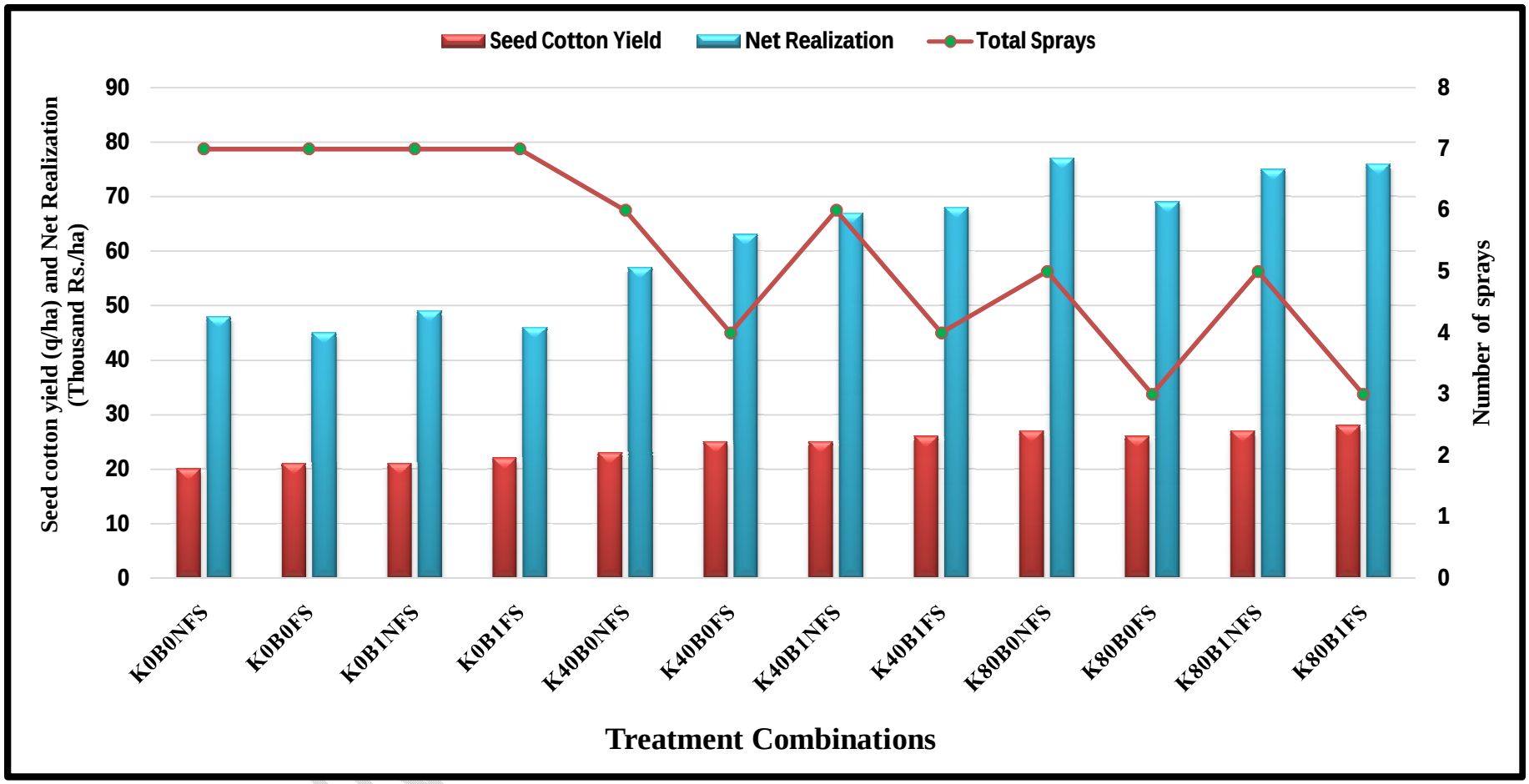

Fig. 2: Number of sprays for insect pest management, seed cotton yield and net realization in various treatment combinations