TAMMAN' A NEW PROMISING VARIETY OF CHICKPEA DEVELOPED FOR RAINFED AREAS OF PUNJAB

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ABSTRACT: Development of new crop varieties is a continuous process as old cultivars become prone to various biotic and abiotic stresses. The newly developed *Kabuli* Chickpea variety "Tamman" has high yield (1719 Kg/ha). It is resistant to disease and possesses tolerance to drought. Its seed is medium bold and 100 grain weighs is 31 g. It has been developed through selection method from the material (Chickpea International *Fusarium* Wilt Nursery- 2005-06) of the International Centre for Agriculture Research in the Dry Areas (ICARDA). Selection of a promising progeny of single plant was made hat had parentage/pedigree Flip-03-134c/Flip-98-52cxFlip-98-41cand was named as 6KCC-122. Its performance was further assessed along with check varieties in yield trials conducted during a period of six years from 2006 to 2012. It was observed in all replicated yield trials that the line 6KCC-122 had the higher yield than that of the standards varieties. It was resistant to insects, diseases and had tolerance against drought. The main characters of this line that contributed towards yield were number of primary and secondary branches, number of pods per plant, 100 grain weight and pod length. On the basis of the desirable characters and higher yield (Kg/ha), this line was approved with the name of "Tamman" by the Punjab Seed Council for its cultivation on commercial level in the rain fed areas of the Punjab province. Due to the desirable characters, the Tamman variety of kabuli chickpea will be a good substitute of previously cultivated varieties. It will also contribute towards increasing the productivity as well as the farm income of the chickpea growers of the area.

Keywords: Rainfed, Kabuli, Chickpea, Tamman and Drought tolerant.

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INTRODUCTION

Chickpea (*Cicer arietinum* L.) is a crop of temperate regions having its origin in south-eastern Turkey, from where its cultivation extended to the other countries of the globe. Process of variety development has been very helpful in increasing the production of different crops (Shabbir *et al*., 2011). Efforts for crop improvements have made adaptation of this crop possible to warmer subtropical areas. There are two very common types of chickpea i.e., "*Kabuli*" and "*Desi*". Desi types are most common in Asia, some parts of Australia and Africa, whereas, Kabuli types are generally cultivated in Europe and America (Zali and Sabaghore, 2011). They contain areas with temperate climate. The northern parts of our province also have areas with mild temperate climate. These areas have good potential for the successful cultivation of *Kabuli* types. So there is a dire need to focus the attention to develop Kabuli varieties which may eventually be helpful to accomplish the goal of self-sufficiency in the production. Chickpea is one of the significant plant origin protein sources and its consumption is continuously increasing as a substitute for animal protein especially in the vegetarian diets (Zali and Sabaghore, 2011; Kristensen *et al*., 2016). Besides being a good source of protein for feed, it is a good rotational crop and improves soil fertility (Goa and Ashamo, 2016).

India is the major producing country of chickpea in terms of area as well as production having an average yield of 782.4Kg/ha. Pakistan ranks second in its production in terms of area and production. Punjab has the major contribution of chickpea production in Pakistan with the highest share in area and production (77% and 83%, respectively) among the provinces (Anonymous, 2010-11). In Punjab, major production comes from the rain fed tract, where it is being cultivated on 89% of the total chickpea area in the Punjab with 84% of the production (Ali *et al*., 2011). There is a dire need for development of high yielding varieties of chickpea in order to get the increased farm income and improve livelihood for betterment of the growers (Khattak *et al*., 2007). Use of improved and high yielding seed with better management practices can help increase per acre yield of chickpea in low intensity zone (Abbas *et al*., 2017). Yield may considerably be improved through development of varieties having preferred combinations of yield related characters (Shafiq *et al*., 2011). In this perspective, a high yielding variety (Thal, 2006) having moderate resistance to blight has earlier been released for arid area of the Punjab (Arshad *et al*., 2008).

In general, Kabuli chickpeas have low grain yield due to scarcity of productive cultivars and non-availability of varieties with resistance against various abiotic and biotic stresses. Non availability of good quality seed is another contributing factor in this regard. Among the fungal diseases, chickpea wilt is a serious issue particularly in the rain fed areas that causes the wilting of plants (Mahmood *et al*., 2011). The aim of current study was to develop a *Kabuli* chickpea variety for Northern Punjab which is first one its kind in *Potohar*. The new chickpea variety "Tamman" has the ability to overcome these problems due to its important genetic characters like higher yield, drought tolerance and disease resistance, hence has been released for commercial cultivation in the arid areas of Punjab. This paper illustrated the breeding history of the "Tamman" variety, which was approved by Punjab Seed Council for its cultivation on large scale in the rain fed areas.

MATERIALS AND METHODS

Procedure adopted by Naeem-ud-Din *et al*. (2009) was followed for varietal development process. An elite line of *Kabuli* chickpea (6KCC-122) was selected from Chickpea International *Fusarium* Wilt Nursery- 2005-06 of the ICARDA at Barani Agricultural Research Institute (BARI), Chakwal. It was a promising progeny of single plant that had parentage/pedigree Flip-03-134c/Flip-98-52c x Flip-98-41c. Evaluation of its performance was carried out in different replicated yield trials along with check varieties. Screening for disease and insect resistance was done under rain fed conditions during period from 2006 to 2012.The breeding history of "Tamman" variety is shown in Table1. All the yield trials were conducted according to randomized complete block design. Spacing between plants and rows were kept at 10 and 30 cm, respectively. All standard agronomic cultural practices were followed to conduct various nurseries and yield trials. Recommended fertilizer doses were applied. Field trials were conducted on sandy loam soil. Data were recorded for different plant traits in various experiments and analyzed statistically using software Statistix 8.1.

RESULTS AND DISCUSSION

A: Yield Performance Trials: Chickpea (*Kabuli*) preliminary, regular and micro yield trial was performed during the years 2006-07, 2007-08 and 2008-09, respectively at research area of the BARI, Chakwal. National Uniform Yield Trials were performed during 2009-10 and 2010-2011. Spot examination was performed during 2011-12. Then its case was submitted to expert sub- committee for approval. Finally it was approved by Punjab Seed Council for general cultivation. Table 2 shows the significant differences ($P<0.05$) among the varietal means for seed yield in preliminary yield trial of chickpea (*Kabuli*). Among the tested genotypes, 6KCC-122 had the highest seed yield of 734 Kg/ha. It was followed by 6KCC-114, which gave a seed yield of 685 Kg/ha. In comparison with check varieties, 6KCC-122 gave 66% and 84% higher seed yield than that of Noor-91 and CM-2000 respectively. Likewise, 6KCC-122 produced a seed yield that was 13% and 28% higher as compared with the check varieties CM-2000and Noor-91, respectively in regular chickpea yield trial as shown in Table3. As far as micro chickpea yield trial is concerned, on an average, 6KCC-122 gave 32 % and 61% higher yield than that of check varieties viz., CM-2000 and CM-2008 (Table 4). These results are similar to earlier findings of Moucheshi *et al*. (2010) and Arshad *et al*., (2008) who also reported substantial increase in seed grain yield of newly developed varieties compared to standard check varieties.

B: Regional Adaptability Trials: National Uniform Yield Trials of Chickpea (Kabuli) were conducted during 2009-10 and 2010-11. Genotype 6KCC-122 was observed to have higher yield than that obtained in case of check varieties. During the two years, data obtained from 15 locations showed that 6KCC-122 gave 4%, 7% and 34% higher average yield than that of the varieties CM-2008, Noor-2009 and Noor-91, respectively (Table 5, 6 & 7). Results regarding the cooperative yield trial obtained from seven locations depicted that 6KCC-122, on an average gave the highest yield i.e., 1719 Kg/ha. On the other hand, CM-2008 and Noor-2009 gave a yield 1634 Kg/ha and of 1708 Kg/ha, respectively (Table 8). Average yield performance of 6KCC-122 at 28 locations showed that itgave4%, 19%, 34% and 26% higher yield than that of standard cultivars, Noor-2009, CM-2008, CM-2000 and Noor-91, respectively (Table9). Earlier researchers like Yadav *et al*., 2010 and Alwawi *et al*., 2009 also reported increase in yield performance and higher adaptability of newly developed chickpea genotypes under studies in all environments owing to their broader genetic make-up.

C: Agronomic Trials: In the agronomic trial conducted during 2001-12 at BARI, Chakwal, and the highest yield of 1550Kg/ha was produced by the elite line 6KCC-122 when planting was done on 15th October. It was followed by the yield of the same genotype giving a production of 1360 Kg/ha when planted on 1st November (Table10). So the best time for its sowing will be from 10th October to 25th October. Detopping effect of Mepiquat Chloride application was tested on the chickpea production under irrigated conditions. Mepiquat chloride (MC), which is a gibberellin acid inhibitor, inhibits cell elongation and restricts overgrowth in plants (Polat *et al*., 2017). The study was carried out at Agronomic Research Institute, Faisalabad during 2011-12. The genotype 6KCC-122 gave better response to application of Mepiquat Chloride

as shown in Table 11. To optimize the fertilizer requirements, 6KCC-122 was tested at ten fertility levels during 2010-11 & 2011-12 on sandy loam soil with 5.3 mg/Kg available phosphorus and 0.5% organic matter at BARI, Chakwal. Based on two years study performance, 6KCC-122 showed better response to the fertilizer dose of 25-90-30 NPK Kg/ha (Table12) due to its inherent potential.

D: Plant Protection Trials: Screening trial against *Fusarium* Wilt was conducted in the Plant Pathology Laboratory of BARI, Chakwal during 2007-08 and at Pathology Research Institute, Faisalabad during 2011-12. The results obtained from both the laboratories are given in Table 13 and Table 14. Results regarding screening of chickpeas against *Fusarium* Wilt show that 6KCC-122 (Tamman) remained at par with the check varieties; CM-2008 and Noor-91. Screening against insect pests was conducted at the Entomological Research Institute Faisalabad during 2011-12. Results showed the resistance of 6KCC-122 resistant to gram pod bore (Table 15). Chaudhry *et al*.(2006); Shah *et al*., 2009 and Shafiq *et al*.(2011) also affirmed the similar deduction for resistance of chickpea varieties against *Fusarium* Wilt.

Distinctive characteristics of the new Kabuli chickpea variety "TAMMAN": The newly developed *Kabuli* chickpea variety "Tamman" has bushy type plants having light green color and medium sized leaves. Plants are semi erect in growth habit, while they mature uniformly (Figure 1&2). Under rain-fed conditions, it comes to flowering in 140 to 142 days and reaches the maturity in 180-185 days. Plants of Taman variety have large number of primary as well as secondary branches and number of pods. Its seed is medium bold and 100 grain weight is 31 g. This variety has an average yield of 1756Kg/ha (Table16). Tamman has also been proved a disease resistant and drought tolerant variety.

Table-1: Breeding history of Tamman (6KCC-122).

Year	Pedigree	Remarks
2005-06	Flip-03-134c/Flip-98-52cxFlip-98-41c	Selection from *Fusarium* Wilt Nursery (ICARDA)
2006-07	6KCC-122	Preliminary Yield Trial
2007-08	6KCC-122	Regular Yield Trial
		Screening against *Fusarium* Wilt Trial
2008-09	6KCC-122	Micro Yield Trial
2009-10	6KCC-122	National Uniform Yield Trial (9 locations) Rank 1st
2010-11	6KCC-122	National Uniform Yield Trial (6 locations) Rank 3rd
		Fertilizer Requirement Trial
		Cooperative Yield Trial (7 locations) Rank 1st
2011-12	6KCC-122	Sowing date Trial
		Fertilizer Requirement Trial
		Screening against *Fusarium* Wilt Trial
		Screening against insect pests
		Effect of growth retardant and Detopping on Chickpea Trial

Table-2: Seed yield of various *Kabuli* chickpea genotypes during 2006-07 in preliminary yield trial.

Sr. No.	Genotypes	Seed yield (Kg/ha)
1	**6KCC-122**	**734**
2	6KCC-114	685
3	6KCC-121	537
4	6KCC-115	515
5	6KCC-118	507
6	6KCC-112	485
7	**Noor-91 (c)**	**441**
8	**CM-2000 (c)**	**400**
9	6KCC-113	289
10	6KCC-117	259
11	6KCC-120	244
12	6KCC-116	205
13	6KCC-119	178
LSD(0.05)		94.99
CV %		13.37
Yield of 6KCC-122 increase/decrease(%) over checks		Noor-91=66% CM-2000=84%

Table-3: Seed yield of various *Kabuli* chickpea genotypes during 2007-08 in regular yield trial.

Sr. No.	Entries	Seed yield (Kg/ha)
1	**6KCC-122**	**2548**
2	6KCC-115	2474
3	6KCC-108	2381
4	6KCC-121	2292
5	**CM-2000 (c)**	**2256**
6	6KCC-114	2173
7	**Noor-91(c)**	**1996**
8	6KCC-105	1990
9	6KCC-103	1975
LSD (0.05)		390
CV (%)		7.3
Yield of 6KCC-122 increase/decrease(%) over checks		CM-2000=13% Noor-91=28%

Table-4: Seed yield of various *Kabuli* chickpea genotypes during 2008-09 in micro yield trial

Sr.No	Genotypes	Seed yield (Kg/ha)
1	6KCC121	1479
2	**6KCC122**	**1407**
3	6KCC114	1360
4	6KCC108	1202
5	6KCC115	1183
6	**CM-2000 (c)**	**1069**
7	**CM-2008 (c)**	**874**
LSD(0.05)		107
CV %		4.93
Yield of 6KCC-122 increase/decrease(%) over checks		CM-2000=32% CM-2008=61%

Table-5: Yield performance of 6KCC-122 (Kg/ha) at different locations during 2009-10 in NUYT.

Sr. No.	Entry Name	BARI CKL	NIAB, FSD	ARI, Karak	AZRI, DIK	BARS, Sakrand	ARI, Quetta	BARS, F.Jang	AZRI, BKR	AARI, FSD	Mean
1	**6KCC-122**	**2187**	**1488**	**440**	**2596**	**772**	**1481**	**235**	**110**	**568**	**1097**
2	**CM-2008(c)**	**2319**	**1370**	**417**	**2512**	**966**	**1088**	**211**	**213**	**379**	**1053**
3	73111-1	1764	1102	713	2996	1078	764	292	251	215	1019
4	K-6006	2097	1599	301	1942	794	1134	220	338	458	987
5	K-6054	1896	1399	289	1817	759	949	246	146	329	870
6	**Noor-91(c)**	**1708**	**1184**	**231**	**1694**	**950**	**810**	**195**	**127**	**472**	**819**
7	6KCC-121	1757	1004	569	1446	752	949	237	163	229	790
8	CH 76/02	2055	1047	333	1587	665	694	283	59	318	782
9	Rabat	1667	641	537	2094	1050	440	291	96	83	767
10	CH 38/00	1924	1090	268	1189	842	694	285	150	263	745

CV: 15.93, Genotype (G), Locations (L) and G*L different highly significant at ($p<0.01$)

Table-6: Yield performance of 6KCC-122 (Kg/ha) at different locations during 2010-11 in NUYT.

Sr. No.	Entry Name	NARC ISD	BARI, CKL	AZRI, BKR	NIAB, FSD	AARI, FSD	ARI, Quetta	Mean (Kg/ha)
1	60062	2100	1840	3282	2092	1576	630	1920
2	NCS-0709	2548	1819	2428	2410	1222	810	1873
3	**6KCC-122**	**2386**	**2028**	**2431**	**2216**	**961**	**771**	**1799**
4	60054	1766	1257	3277	2160	1565	736	1794

5	CC121/00	2680	1604	2392	2558	900	569	1784
6	CM1528/03	2315	1236	2247	2694	1282	690	1744
7	**Noor-2009(c)**	**3171**	**1701**	**1859**	**1460**	**1120**	**806**	**1686**
8	CM1529/03	1728	1688	2359	2344	910	808	1639

CV: 11.78, Genotype (G), Locations (L) and G*L different highly significant at ($p<0.01$)

Table-7: Average yield performance of 6KCC-122 in NUYTs at 15 different locations.

Year	**Locations**	**Seed Yield (**Kg/ha**)**			
		6KCC-122	Noor-91(c)	CM-2008 (c)	Noor-2009 (c)
2009-10	9	1097	819	1053	-
2010-11	6	1799	-	-	1686
Average		1448	819	1053	1686
Year Wise Yield of 6KCC-122 Increase/Decrease (%)over Checks.			**34**	**4**	**7**

Table-8: Yield performance of 6KCC-122 (Kg/ha) in cooperative yield trial at seven different locations.

S. No.	**Genotypes**	**PRI, FSD**	**NIAB, FSD**	**GBRSS, Kohat**	**BARI, CKL**	**RARI, BWP**	**ORSS, Piplan**	**AZRI, BKR**	**Av. Yield**
1	**6KCC-122**	**2535**	**2688**	**1701**	**708**	**1181**	**2743**	**468**	**1719**
2	K-06006	3369	2562	2014	528	1458	1545	559	1719
3	CM956/06	2574	2224	1493	576	1389	3299	476	1719
4	**Noor-2009(c)**	2517	2591	1667	569	1319	2813	482	**1708**
5	K-08003	3638	2172	1806	361	1250	2118	478	1689
6	K-06005	3017	2399	2083	521	1389	1753	522	1669
7	K-08004	3344	2376	1632	521	764	2118	494	1607
8	**CM-2008(c)**	2419	2206	1424	639	1250	3021	482	**1634**
9	CM770/06	2694	2298	1736	493	1389	2188	508	1615
10	K-08001	3281	2149	1944	313	1458	1510	519	1596
11	CM739/06	2271	2495	1563	549	1389	2378	460	1586
12	K-08020	2792	2199	1840	694	833	2031	448	1548
13	CM759/06	2320	2510	1389	646	694	2674	507	1534
14	K-08002	2939	2351	1875	549	1042	1406	463	1518
15	K-08023	3239	2024	1701	639	278	1962	523	1481
16	CM64/06	2194	2282	1181	563	903	2431	532	1441
17	CM579/06	2225	2527	1493	556	903	1632	491	1404
18	CM601/06	1974	2280	1250	361	833	2101	472	1324

CV: 12.10, Genotype (G), Locations (L) and G*L different highly significant at ($p<0.01$)

Table-9: Average yield performance of 6KCC-122 in 28 locations.

Year	**Name of Trial**	**No. of Locations**	**6KCC-122**	**Noor-91**	**CM-2000**	**CM-2008**	**Noor-2009**
2006-07	PYT	1	734	441	400	-	-
2007-08	RYT	1	2548	1996	2256	-	-
2008-09	MYT	1	1407	-	1069	874	-
2009-10	NUYT	9	1097	819	-	1053	
2010-11	NUYT	6	1799	-	-	-	1686
2011-12	CPT	7	1719	-	-	1634	1708
2011-12	SDT	1	1550	-	-	-	-
2010-12	FT	2	1326	-	-	-	-
MEAN			1755.90	1085.33	1242.00	1187.00	1697.00
Yield of 6KCC-1222 increase/decrease (%) over Checks				34	26	19	4

Table-10: Seed yield (Kg/ha) as influenced by various sowing dates of 6KCC-122.

Cultivar	**Sowing Dates*** (**Yield** in Kg/ha)				
	15th Sept	1st Oct	**15th Oct**	1st Nov	15st Nov
6KCC-122	1320	1120	**1550**	1360	970

*Sowing Date: LSD (0.05) = 68, CV (%)= 3.7

Table-11: Effect of growth retardant and detopping on yield of Chickpea (*Kabuli*) 6KCC-122.

	Grain Yield (Kg/ha)			
Treatments	**R1**	**R2**	**R3**	**Mean**
Control	1222	1556	1333	1370
Mepiquat chloride application @25 g a.i ha^{-1} at 60 days after sowing	1444	1333	1778	1518
Mepiquat chloride application @25 g a.i ha^{-1} at 75 days after sowing	1556	1889	1333	1593
Mepiquat chloride application @25 g a.i ha^{-1} at 60 and 75 days after sowing	1667	1444	1444	1518
Detopping 75 days after sowing	1222	1556	1889	1556

Table-12: Seed yield as affected by different levels of fertilizers

Sr. No.	**Fertilizer Levels** (Kg/ha)			**Genotypes Yield** (Kg/ha)		
	N	P2O5	K2O	6KCC-122 **2010-11**	6KCC-122 **2011-12**	Mean
1	0	0	0	941	556	749
2	0	60	30	1029	681	855
3	12.5	60	30	1091	702	897
4	25	60	30	1083	914	999
5	37.5	60	30	1091	943	1017
6	25	0	30	1116	1007	1062
7	25	30	30	1336	1010	1173
8	**25**	**90**	**30**	**1519**	**1132**	**1326**
9	25	60	0	1347	1050	1199
10	25	60	60	1164	950	1057
		Varieties		Fertilizer	Interaction	
	LSD (0.05) =	49		26	44	
	CV% =	4.8				

Table-13: Screening of chickpea genotypes against *Fusarium wilt* during 2007-08 at Barani Agricultural Research Institute, Chakwal.

Sr. No.	**Entry Name**	**Severity0-5%**	**Sr. No.**	**Entry Name**	**Severity0-5%**
1	6KCC-103	2.67	6	6KCC-121	2.67
2	6KCC-105	1.00	7	6KCC1-22	2.00
3	6KCC-108	1.33	8	Noor-91	1.33
4	6KCC-114	2.00	9	CM-2000	1.33
5	6KCC-115	1.33			
		LSD (0.05)	1.03		
		LSD (0.01)	1.42		

Note: 0 -Immune, 1-10 - Highly Resistant and 11-20 -Resistant

Table-14: Screening of gram genotypes against *Fusarium Wilt* during 2011-12 at Pathology Research Institute, Faisalabad.

Sr. No.	**Name of Variety / Line**	**Level of resistance / susceptibility**
1	6KCC-122	Resistance
2	Thal-2006 (check)	Susceptible

Table-15: Screening of Gram Genotypes against Insect Pests during 2011-12at Entomology Research Institute, Faisalabad

Sr. No.	Genotypes	Gram Pod Borer (% Infestation)
1	6KCC-122 (Gram)	6.79
2	Noor-2009 (Gram)	7.09
	LSD @ 0.05%	N.S

Table-16: The important characteristics of the new *Kabuli* chickpea variety "Tamman" and check varieties Noor-2009 and CM-2008 on average basis.

Characteristics	Tamman	Noor-2009	CM-2008
Days to 50% flowering	140±3	141±6	145±5
Days to maturity	180±5	185±8	184±6
Main stem length(cm)	60±3	63±3	58±3
No of primary branches/plant	5±1	3±1	3±1
No. of secondary Branches/plant	9±2	5±2	6±2
Pod length (cm)	3±1	2±1	2±1
Pods/plant	75±5	59±6	38±5
Grains / pod	2	2	2
100 grain weight (gm)	31±1	29±2	23±2
Average yield (Kg/ha)	1756	1697	1187

Figure-1: Bushy type plant of "Tamman" **Figure-2: Uniform maturity of "Tamman**

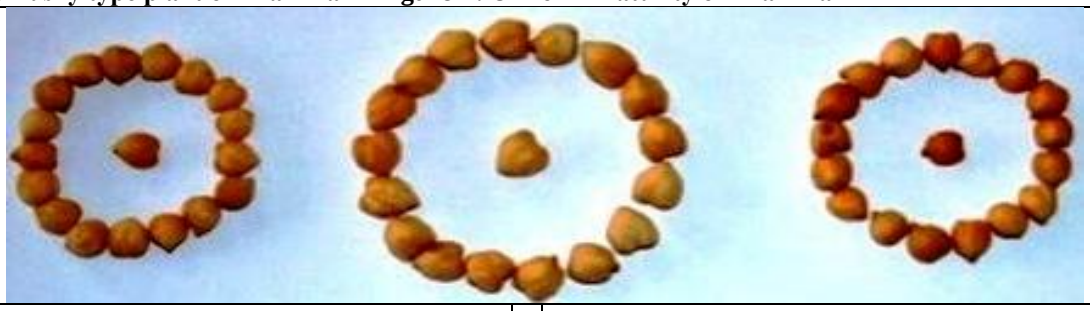

Figure-3: Comparison of grains of Noor-2009 (left), Tamman (center) and CM-2008 (right) (Based on 18 grains in circle) showing the grain size and color difference.

Conclusion: Due to the distinct characters and inherent potential of the elite line '6KCC-122' the Punjab Seed Council (PSC) approved as a *Kabuli* chickpea variety 'Tamman' for general cultivation in the arid tract of Punjab. Cultivation of this variety on commercial scale will not only augment the production but it will also grasp more prices in the market by virtue of its whitish creamy seed color as compared to CM-2008 and CM-2000 (Figure 3).

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