Indian J. Genet., 50 (4): 382–389 (1990)

KHARBADAM—A PUTATIVE HYBRID BETWEEN ALMOND AND PEACH

A. S. SOODAN, A. K. KOUL AND B. A. WAFAI

Department of Biosciences, University of Jammu, Jammu 180 001

(Received: May 24, 1984; accepted: October 13, 1989)

ABSTRACT

The paper describes morphology and meiotic behaviour of a peculiar looking almond, locally called *Kharbadam*. It shows some differences with almond and at the same time resembles peach in some of its features. A detailed comparison of its morphology and cytology with almond and peach suggests it to be a spontaneous hybrid between the two fruit species. The role of such hybrids in breeding is discussed.

Key words: *Kharbadam*, almond, peach, hybrid, cytology.

While exploring almond and peach plantations of the Kashmir valley, the authors came across a few trees of a peculiar looking almond, locally called *kharbadam**. These combine characters of almond and peach. The trees were studied in depth for their morphology, chromosome number, and meiotic behaviour. The results of these studies form the basis for the present article.

RESULTS AND DISCUSSION

MORPHOLOGY OF KHARBADAM

The trees are upright and vigorous with light green foliage. Leaf blade measures 7.7–10.2 x 2.1–3.1 cm, the petiole is 1.0–1.5 cm long and petiole: lamina length ratio 0.09–0.19. The trees flower in the first week of April. The flowers are dull-white, arranged singly or in clusters, 50–75 per 50 cm length of the branch. Flower spread ranges from 2.8–3.4 cm. The drupe is spherical, measuring 3.0–3.6 x 2.0–2.5 cm and weighing 8.0–12.6 g. The fruit skin turns yellow on ripening. The perimesocarp is indehiscent, succulent and dull white. The deeply reticulate endocarp, or the nut, measures 2.2–2.8 x 1.9–2.2 cm and weighs 2.4–3.6 g.

**Khar* in Kashmiri language means ass; *badam* means almond. The name obviously refers to the poor quality of the fruit.

The kernel is 1.7–1.85 x 1.1–1.25 cm in size and 390–525 mg in weight. Ratio between kernel weight and stone weight is around 0.14.

POLLEN MOTHER CELL MEIOSIS

Chromosome counts were made in dividing pollen mother cells. All trees of *kharbadam* that were scored had 2n=16. The chromosomes are paired into eight ring (1.8 per cell) or rod shaped (6.2 per cell) bivalents. The chiasma frequency was 9.6 per cell and 1.2 per bivalent.

Kharbadam resembles almond in most of its characters, for which reason it is treated as a variety of almonds by the local orchardists. Its affinity to almond is also indicated by its fairly sweet kernel. Several morphological traits are, however, unique to *kharbadam*, which have been compared below:

Character	**Almond**	**Kharbadam**
Flower size	3.65–5.15 ($\bar{x}$ 4.42 $\pm$ 0.62)	2.82–3.44 ($\bar{x}$ 3.16 $\pm$0.21)
Fruit skin	Green	Light yellow
Perimesocarp	Dry, dehiscent	Succulent, indehiscent
Nut surface	Porous	Reticulate
Taste of kernel	Sweet	Slightly bitter

The characters, in which *kharbadam* differs from almond, it shares with peach. This is particularly true of flower size and nature of perimesocarp. These two fruits differ in some other characters, which is evident from the comparison below:

Character	**Peach**	**Kharbadam**
Tree form	Spreading	Upright
Perimesocarp	Fleshy	Succulent
Stone shape	Oblong	Roundish
Reticulation	Deep	Shallow
Taste of kernel	Intensely bitter	Slightly bitter

To evaluate the phylogenetic distance between *kharbadam*, almond and peach, a comparison has been made (Table 1; Fig 1:13).

Table 1. Qualitative features of almond, kharbadam and peach

Character	Almond	Kharbadam	Peach
Tree morphology	Upright	Upright	Spreading
Flower colour	Dull white	Dull-white	Pink
Petal margin	Wavy	Wavy	Entire
Shape of drupe	Oblong	Spherical	Spherical
Fruit colour	Green	Yellow	Yellow with carmine on exposed side
Perimesocarp	Dehiscent	Indehiscent	Indehiscent
Texture of perimesocarp	Dry, inedible	Succulent, inedible	Fleshy, edible
Markings on endocarp	Small pores	Shallow reticulations	Deep reticulations
Taste of kernel	Sweet	Sweet with bitter principle	Bitter

It can be seen from the above Table 1 and Fig. 1:13 that *kharbadam* is a blend of characters of these two fruits and stands intermediate in its qualitative as well as quantitative characters. The only feature in which it outshines both is its higher yield (apparently, a consequence of hybrid vigour).

The intermediate morphology of *kharbadam* indicates that, in all probability, it is a natural hybrid between almond and peach. Even earlier, such spontaneous intermediate forms have been treated as natural almond x peach hybrids [1–3]. That almond and peach can hybridize is confirmed by the artificial crosses made by Jones [4] And Kozahanone [5]. Even during the course of present investigation, it was found that they cross readily to yield healthy seeds that have fully grown embryos (Fig. 1:12). The artificially produced hybrids resemble such spontaneously occurring forms as *kharbadam* in all morphological characters, which indicates their hybrid nature. Observations on the meiotic behaviour of *kharbadam* also support its hybrid nature. The chiasma frequency of *kharbadam* (9.6 per cell) is lower than that of almond (10.1) as well as peach (10.4), which also reflects its hybrid nature (Table 2).

Chromosome pairing and disjunction are orderly in *kharbadam*. These account for its high fertility as has been stressed earlier by Salesses and Bonnet [6] while working on natural hybrids of almond and peach. The stable cytological behaviour of hybrids reflects the close phylogenetic kinship between almond and peach.

In the Kashmir Valley, the possibility of the two fruit species crossing to yield hybrids is ensured by the overlap in their flowering. Almonds flower from the first week of March to mid-April and peaches from first to third week of April. Thus, the almond and peach blossoms overlap for nearly 8-10 days of April, providing for effective cross pollination. By the time peach comes to flower, some almond trees have completed flowering. As such, only

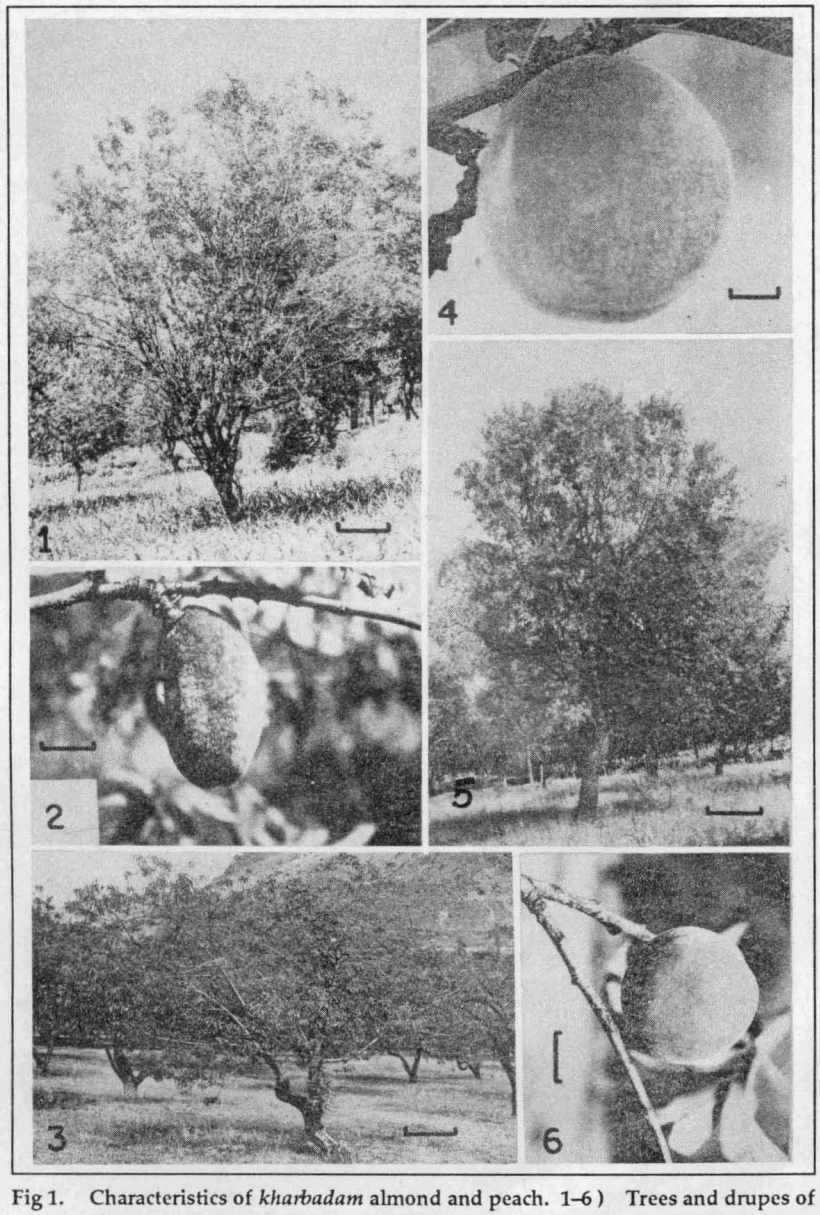


Fig 1. Characteristics of *kharbadam* almond and peach. 1–6) Trees and drupes of almond (1, 2), peach (3, 4) and *kharbadam* (5, 6). Bar = 1 m (in 1, 3, 5) and 1 cm (in 2, 4, 6). 7,8) Metaphase-I plates of almond and peach, respectively (bar = 5 μ). 9, 10) Photomicrograph and camera lucida drawing of metaphase-I plate of *kharbadam* (bar = 5 μ). 11) Stones and kernels of almond (aa'), *kharbadam* (bb'), and peach (cc'). 12) Healthy embryos excised from seeds of peach pistils pollinated with almond pollen. (bar = 1 cm). 13) Graphic representation of some quantitative features of almond, peach, and *kharbadam*.

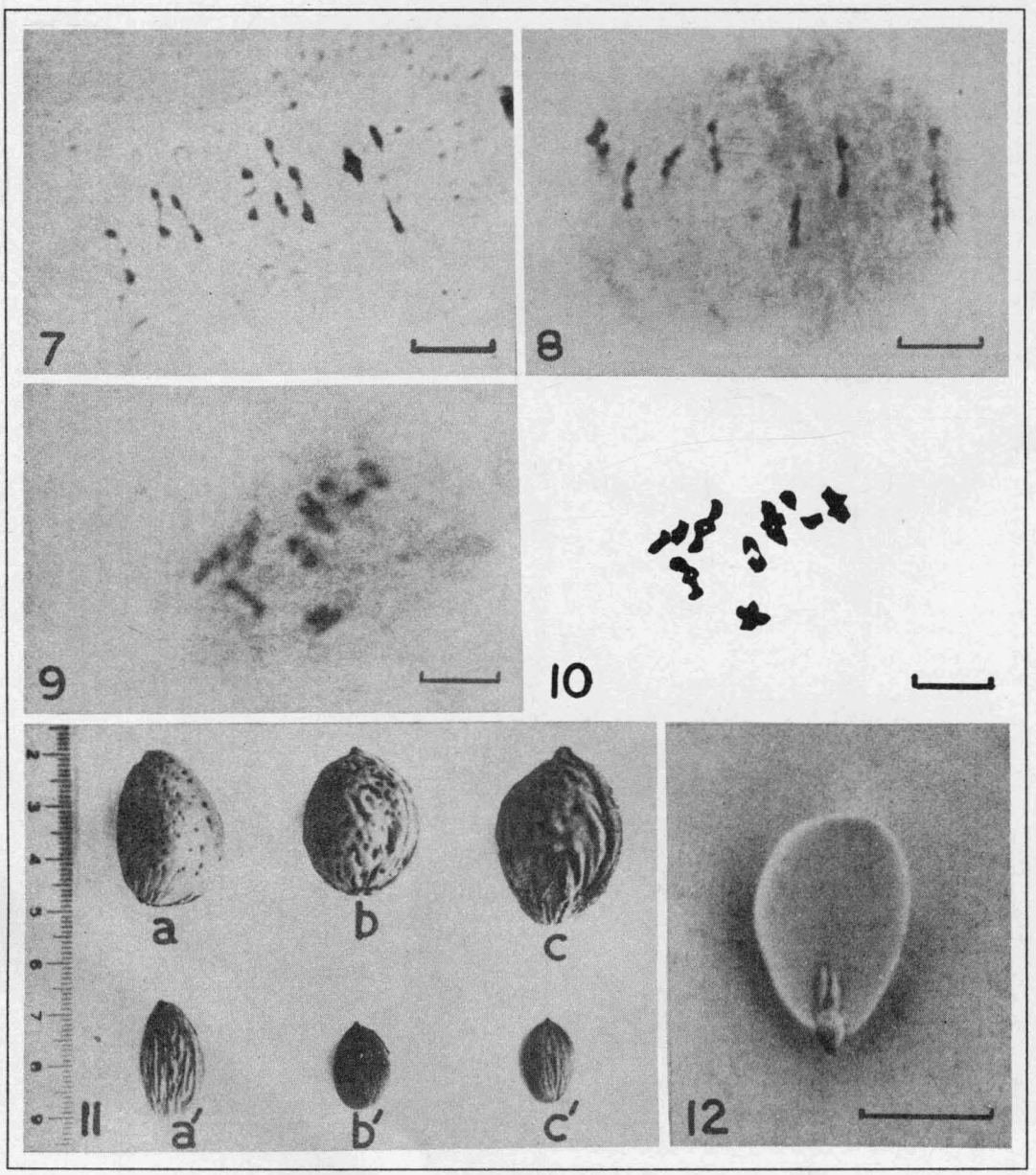
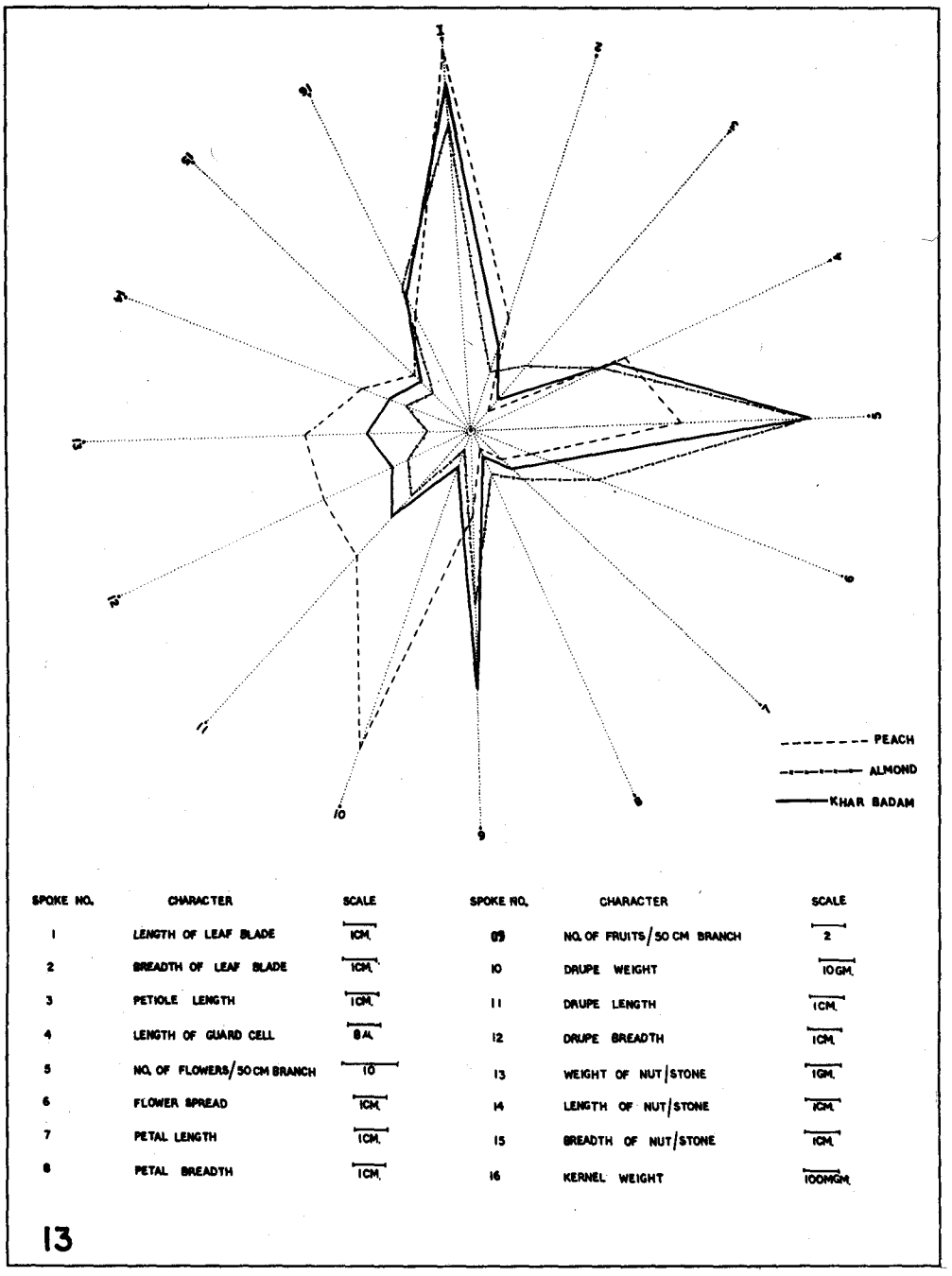


Fig. 1. *(contd.)*



SPOKE NO.	CHARACTER	SCALE	SPOKE NO.	CHARACTER	SCALE
1	LENGTH OF LEAF BLADE	1CM.	09	NO. OF FRUITS/50 CM BRANCH	2
2	BREADTH OF LEAF BLADE	1CM.	10	DRUPE WEIGHT	10GM.
3	PETIOLE LENGTH	1CM.	11	DRUPE LENGTH	1CM.
4	LENGTH OF GUARD CELL	8M.	12	DRUPE BREADTH	1CM.
5	NO. OF FLOWERS/50 CM BRANCH	10	13	WEIGHT OF NUT/STONE	1GM.
6	FLOWER SPREAD	1CM.	14	LENGTH OF NUT/STONE	1CM.
7	PETAL LENGTH	1CM.	15	BREADTH OF NUT/STONE	1CM.
8	PETAL BREADTH	1CM.	16	KERNEL WEIGHT	100MGM.

13

Fig. 1. *(contd.)*

the late flowering almonds may be involved in the formation of *kharbadam*.

Table 2. Meiotic parameters of almond, peach and kharbadam

Parameter	Almond	Peach	Kharbadam
Rod bivalents/cell	5.90	5.29	6.20
Ring bivalents/cell	2.10	2.71	1.80
Chiasmata/cell (MI)	10.10	10.40	9.60
Chiasmata/cell (MII)	1.25	1.30	1.20
Recombination Index	18.10	18.40	17.60

Although *kharbadam* is qualitatively inferior and is therefore of little direct utility, yet it has more than one potentiality. The hybrid is valued as a good rootstock for grafting as it is known to have acquired drought resistance and tolerance to chlorosis and alkaline conditions from almond and resistance to nematodes and ability to produce adventitious roots from peach [7, 8]. In Himachal Pradesh, this hybrid, locally known as behmi, is extensively used as rootstock for stone fruits. Moreover, the hybrids being vigorous and high yielding, can be employed in the improvement programmes of almond and peach. A similar recommendation was made by Singh et al. [9] who reported a peach–almond hybrid from Punjab (locally called *sloh*). This hybrid was notably vigorous and high yielding.

ACKNOWLEDGEMENTS

The authors are thankful to Prof. Y. R. Malhotra, Head, Department of Biosciences, University of Jammu, for providing necessary facilities. A. S. Soodan acknowledges the financial help from CSIR, New Delhi.

REFERENCES

1. C. L. Coates. 1921. The 'peach x almond' hybrid. J. Heredity, **12**: 328–329.

2. D. Sornovsky. 1930. A hybrid between peach and almond. Byul. Prikl. Bot. Genet. Selekts., **24**: 189–203.

3. R. Bernhard. 1949. Peach and almond and its utilizations. Res. Hort., **121**: 97–101.

4. R. W. Jones. 1969. Selection of intercompatible almond and root knot nematode resistant peach rootstocks as parents for production of hybrid rootstock seed. J. Amer. Soc. Hort. Sci., **94**: 89–91.

5. H. D. Kozahanone. 1970. Improvement in Methods of Production of Plant Hybrids between Peach and Almond Species. Thesis. Univ. of Bordeaux.

6. G. Salesses and A. Bonnet. 1971. Morphological and cytological study of almond and peach hybrid and the 4x form induced by colchicine treatment. Ann. Amelior. Plantes, 21: 75–82.

7. D. E. Kester and C. J. Hansen. 1966. Rootstock potentialities of the F_1 hybrids between peach (*Prunus persica* Batsch.) and almond (*Prunus amygdalus* Batsch.). Proc. Amer. Soc. Hort. Sci., 89: 100–109.

8. D. E. Kester and E. Sartori. 1966. Rooting and cuttings in populations of peach (*Prunus persica* Batsch.) and almond (*Prunus amygdalus* Batsch.) and their F_1 hybrid. Proc. Amer. Soc. Hort. Sci., 88: 219–223.

9. K. Kripal Singh, J. C. Bakshi and A. S. Narang. 1969. Prospects of almond cultivation in Punjab. Pb. Hort. J., 9 (3-4): 103–108.

and subsidies. What will be the consequence of such measures on cereal/millet production and the national economy in totality is nowhere discussed.

The book makes an interesting reading as it provides a good insight into the current trends in the Mediterranean agriculture. Many of the problems mentioned are common to ours in this country. The last chapter on Workshop Discussion and Recommendations summarises the various aspects discussed through the Workshop and draws attention to some of the vital problems facing the agriculture in the region.

B. Sharma
Division of Genetics
I.A.R.I., New Delhi 110012